AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS, AND BLACKSMITHS.

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For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Acme Automatic Safety Engine for Boats.

This engine, which is shown by accompanying cut, has two upright single acting cylinders, the cranks being 180° to each other. The long, hollow pistons, 1½ times the stroke in length, form their own guides, the wrist pin being placed just below the center, and the steam rings above it.

The valve, which is of the balanced rocking type, is placed directly over the cylinders, the valve case forming the cylinder head. This arrangement gives opportunity for long ports, which give quick admission, and release and reduces "clearance" to the minimum. The exhaust steam (which escapes through the center of the valve) is led into a heater case which contains a coil of pipe through which the feed water is forced by the pump on its way to the boiler, and is heated to nearly or above the boiling point according to pressure carried in the boiler.

The engine is rigidly attached to its base, and has a pitch toward the stern of boat of ¼″ to the foot when base is level, and no "universal joints" are needed to give the shaft the necessary pitch to submerge the wheel, and yet have rigid shaft connections.

The eccentrics that actuate the valve motion are keyed fast to shaft and cannot slip. The shaft coupling is let into the face of hand wheel sufficiently to make perfect alignment of shaft necessary to get them together.

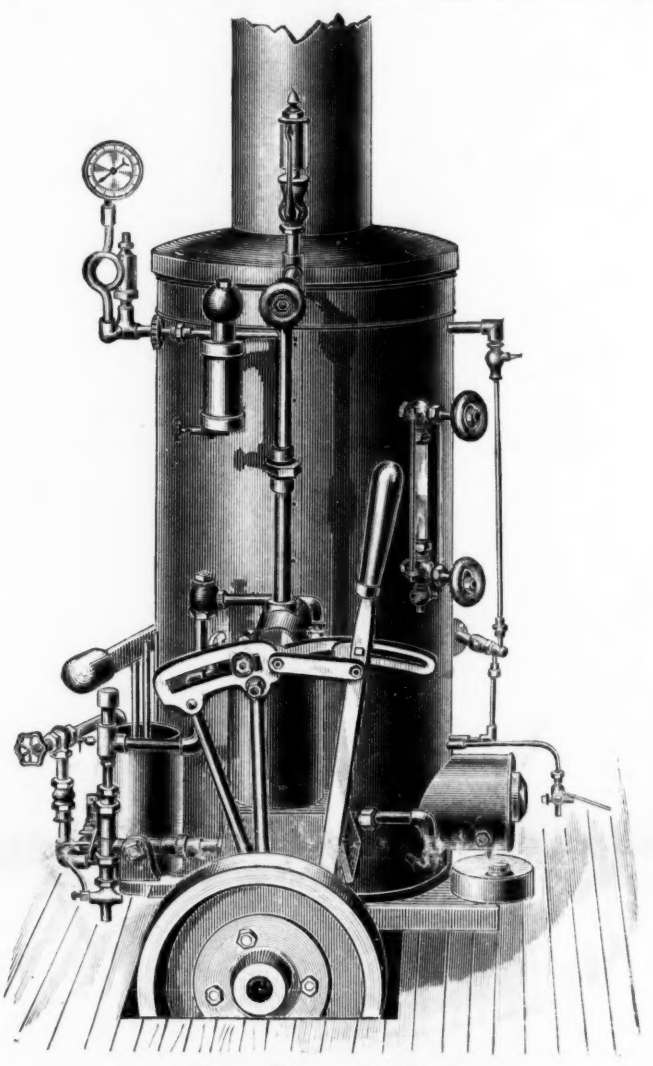
The link is made strong and durable, and is so arranged that there is little lost motion from the block sliding in link.

Lubrication is accomplished by carrying in the crank case a mixture of oil and water, into which the cranks dip at every revolution, and are not only flooded themselves, but throw the oil to every part inside the cylinder and crank case. The strain on the connecting rod is one of compression only, and as the labor is all performed in one direction there is no rattle or jar from lost motion. The cranks, shaft, and wrist pins are of steel of extra large diameter and length of bearing. These engines, combine lightness, strength, and compactness, with silence and freedom from jar at high speeds, and can be reversed instantly under full steam without injury.

The boiler shown in cut is arranged to burn kerosene oil vaporized by a steam jet, and is a rapid and economical steam generator capable of carrying high pressure without danger "to life or limb." These engines are made in sizes 1 to 4 horse-power (nominal) and are also furnished separate from the boiler if desired.

It is claimed that the small floor space occupied, low center of gravity, simplicity of construction, ease of manipulation, combined with durability, make them desirable engines for the uses above specified.

The manufacturers are the Rochester Machine Tool Works, Rochester, N. Y.



SAFETY ENGINE FOR BOATS.

The mechanical engineers were well supplied with the necessities of life at their New York meeting. In addition to being served with a lunch after two of their meetings in the city, and on excursion days, they were entertained by Prof. Morton at his house between the two sessions held at the Stevens Institute.

New Stationary Blast Forge.

The following description and history of this forge is from the manufacturers, the Buffalo Forge Company, Buffalo, N. Y.:

"This forge was originally designed for the Toledo Manual Training School, Toledo, O., whose board desired a light, inexpensive, yet neat, complete and convenient stationary forge adapted to ordinary work. How well we have succeeded is evidenced by the fact that they not only received the approbation of the Toledo board, but we have also received such a number of orders from different parties who have seen them in operation that we have decided to offer them to the trade.

We believe their merit will be appreciated by many in the trade, especially carriage makers and light manufacturers generally.

By reference to cut, it will be seen that the forge rests on a conical pedestal, with coal box on one side and water tank on the other, also tool racks for tongs, etc., on both sides. The fire-place has openings on both ends for raising or lowering depth of fire. The tuyere iron is our improved revolving ball, anti-clinker pattern, with ash-box extended through to side of pedestal, so that ashes can be easily removed. The blast gate has a lever attachment, so that the operator can regulate the blast easily. With canopy hood this makes an attractive, complete and convenient forge."

STATIONARY BLAST FORGE.

Mechanical Engineers.

Shortly before 9 o'clock on Friday morning, December 3, the members of the American Society of Mechanical Engineers began to assemble in the Pennsylvania Railroad depot, for the purpose of making an excursion to Trenton, N. J., and there visit Mayor-elect Hewitt's establishment. The weather was exceedingly fine, putting all in a cheerful and happy mood. A very enjoyable time was anticipated, which was more than fully realized. The P. R. R. had provided a special train for the occasion, which, with the very courteous conduct of the railroad officials, was fully appreciated by the members of the society. The party numbered about 300 persons, including many ladies. Arriving at Trenton, the train was switched off the main track and run into the yard of Mr. Hewitt's establishment. The excursionists were heartily welcomed by the officers of the works, and then conducted into the rolling mill, where the process of rolling bar iron and iron beams was witnessed with great interest. The time required for rolling heavy beams, and the ease with which these were handled was surprising. The I beams rolled at the time of the visit were, we should judge, about 12 inches deep and about 15 feet long. The time required for rolling one of these bars from a rectangular piece or billet was about two minutes.

The bridge department was visited next, and the special tools for punching, riveting and squaring off the ends of girders examined. After seeing all the sights in this department the party was conveyed by train to a place in the same establishment, where an excellent lunch was provided for all. During lunch hour regret was expressed for the unaccountable absence of Mr. Hewitt; a vote of thanks was passed by the society for the kind greeting and courtesy they had received, and invitations extended to them by other manufacturers to visit their establishments.

After lunch the party witnessed the process of making all kinds of wire, No. 40 wire being the finest wire manufactured in these works. The excursionists next availed themselves of the opportunity to visit the Trenton pottery, in which the manner of making and decorating crockery was shown and explained. In this the ladies were particularly interested, often asking questions, which finally revealed a secret: namely, the source of the greater part of our imported crockery. All the dishes that were examined had a foreign stamp, and this, the superintendent frankly admitted was put on the dishes for the purpose of a little deception, as the American public has a great fancy for imported goods, and will buy such in preference to home made articles. The excursion was a complete success and creditable to all concerned.

Practical Drawing.

By J. G. A. Meyer.

TENTH PAPER.

Problem 3.

109. TO DRAW A LINE PERPENDICULAR TO A STRAIGHT LINE FROM A GIVEN POINT OUTSIDE OF THAT LINE.

Fig. 74. Let *B D* be a straight line of unlimited length, and let *A* be a given point outside of the line *B D*.

Take any point as *E* on the other side of the line *B D*; from the point *A* as a center and with a radius equal to the distance between the given point *A* and the point *E* draw the arc *F G*, cutting the straight line in the two points *F* and *G*. From the point *F* as a center, and with a radius greater than half the distance *F G*, describe an arc *C*, and with the point *G* as a center, and with the same radius as used for the arc *C* describe another arc, cutting the arc *C* in the point *H*. Join the points *A* and *H* by a straight line; this line will be the perpendicular required.

The line *A H* is perpendicular to the line *B D* because the two points *A* and *H* in the line *A H* are equally distant from the two points *F* and *G* in the line *B D*. (See article 39.)

Direction.—In the space marked Problem 3 draw an oblique line *B D*, that is a line not parallel to any of the division lines on the sheet. Above the line *B D* choose any point and mark it *A*. Then through this point *A* draw a perpendicular in a manner as just explained.

Draftsman's method: This is similar to that as explained at the end of Problem 1.

Problem 4.

110. TO BISECT A GIVEN STRAIGHT LINE.

Fig. 75. Let *A B* be the given straight line; it is required to bisect the same.

From the end *A* of the line as a center and with a radius greater than half the length of the line *A B* describe an arc of a circle; from the end *B* of the line as a center and with the same radius as before, describe another arc intersecting the former in the two points *D* and *E*. Through these points of intersection draw the straight line *D E*; this line will bisect the line *A B* in the point *C*.

Since the two points *D* and *E* are equally distant from the extremities *A* and *B*, both must lie in the perpendicular raised from a point in the center of the line *A B*. Therefore the line *D E* divides the line *A B* into two equal parts at the point *C*. (See article 40.)

Directions.—In the space marked Problem 4 draw any straight line; mark one of its extremities *A* and the other *B*; then bisect the line *A B* according to the instructions given in this problem.

Draftsman's Method.—Draftsmen generally adopt this geometrical method for bisecting any straight line either long or short. Sometimes draftsmen divide a line with a pair of dividers by trial. We prefer the geometrical method.

Problem 5.

111. AT A GIVEN POINT IN A STRAIGHT LINE TO MAKE AN ANGLE EQUAL TO A GIVEN ANGLE.

Let *A B* in Fig. 76 be the given straight line; and *A* the given point in this line. Let *C* in Fig. 77 be the given angle. It is required to draw from the point *A*, a straight line which shall make an angle with the line *A B* equal to the given angle at *C*. From the point *C* (Fig. 77) as a center, and with any radius describe the arc *D E* terminating in the sides of the given angle; join the points *D* and *E*, or in other words, draw the chord *D E*. From the point *A* (Fig. 76) as a center and with the same radius as that used for describing the arc *D E*, in Fig. 77, draw an indefinite arc *H F*, cutting the straight line *A B* in the point *F*. From this point *F* as a center, and with a radius equal to the length of the chord *D E*, draw a short arc cutting the arc *H F* in the point *G*. Through the points *A* and *G* draw a straight line *A G*; then the angle *B A G* will be equal to the given angle *C*. Join the points *G* and *F* by a straight line; this line *G F* will be the chord of the arc described from the point or center *A*.

The angle *A* must be equal to the angle *C*, because they are subtended by equal arcs. (Article 42.)

The arc *G F* must be equal to the arc *D E* because these are described with equal radii, and have equal chords.

Directions.—In the upper part of the space marked Prob. 5, draw any two straight lines forming an angle; assume this to be the given angle. In the lower part of the same space draw a straight line *A B*. Then at the point *A*, in the straight line *A B*, construct an angle according to the instructions given in this problem.

Draftsman's Method.—In the construction of equal angles the draftsman always adopts this geometrical method, because other methods will not enable him to do it quicker.

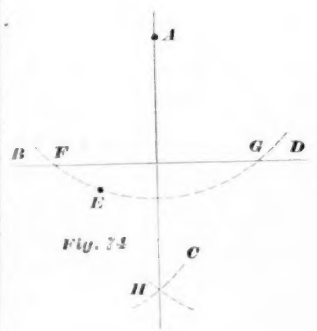


Fig. 74

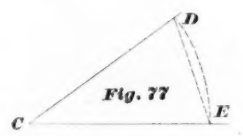


Fig. 77

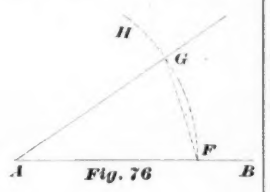


Fig. 76

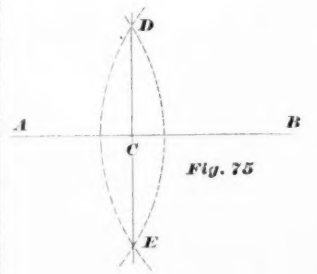


Fig. 75

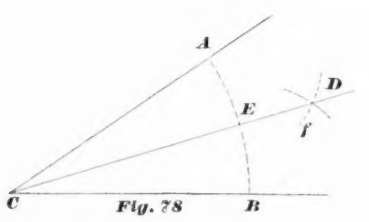


Fig. 78

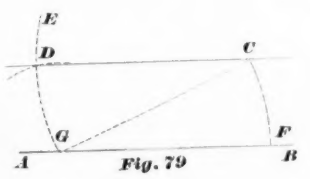


Fig. 79

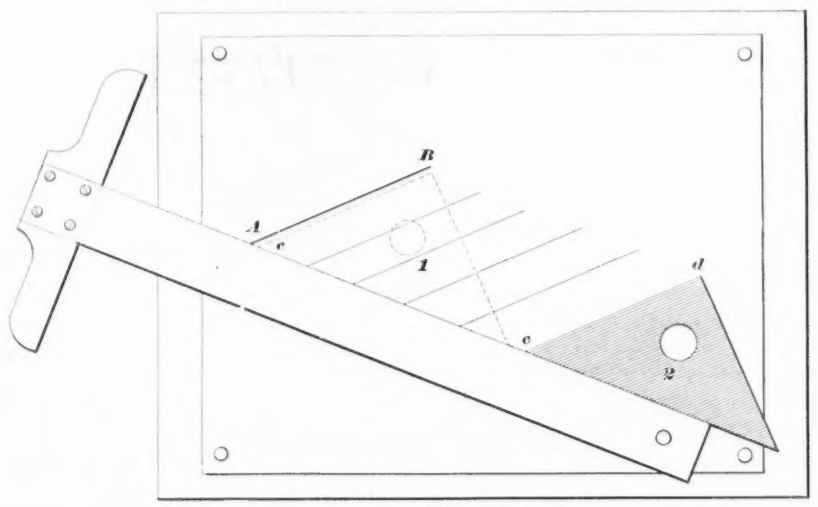


Fig. 80

Problem 6.

TO BISECT A GIVEN ANGLE.

112. Fig. 78. Let *A C B* be an angle which it is required to bisect.

From the point *C* (that is the vertex of the angle) as a center and with any radius describe the arc *A B*; this arc will intersect the sides of the angle in the points *A* and *B*.

From the point *A* as a center, and with any radius greater than half the distance between *A* and *B*, describe a short arc *f*; from the point *B* as a center, and with the same radius as used for the arc *f*, describe another arc intersecting the former in the point *D*. Through the points *D* and *C* draw the straight line *C D*; the angle *A C E* will be equal to the angle *E C B*, and the arc *A E* will be equal to arc *E B*, hence the line *C D* will divide the angle *A C B* into two equal parts.

Directions.—In the space marked Prob. 6, draw any two straight lines forming an angle at *C*. Divide this angle in a similar manner as shown in this problem.

Draftsman's Method.—Draftsmen always adopt this geometrical method for dividing angles, as better methods cannot be obtained.

Problem 7.

113. TO DRAW THROUGH A GIVEN POINT A STRAIGHT LINE PARALLEL TO A GIVEN STRAIGHT LINE.

Fig. 79. Let *C* be the given point and *A B* the given line; it is required to draw a straight line through the point *C* parallel to the given line *A B*.

From the point *C* as a center and with a radius greater than the shortest distance from the given point *C*, to the line *A B*, describe an indefinite arc *E G*, cutting the given line in the point *G*; from the point *G* as a center, and with the same radius as before, describe the arc *C F*, cutting the given line *A B* in the point *F*; of course if this arc is accurately drawn it will and must also pass through the given point *C*. From the point *G* as a center and with a radius equal to the distance between the points *F* and *C*, describe a short arc intersecting the arc *G E* in the point *D*. Through the points *C* and *D* draw a straight line; this line will be parallel to the given line *A B*.

The line *C D* is parallel to *A B* because by drawing a straight *G C* through the points *G* and *C*, we find that the angle *D C G* and the angle *C G F* are equal, because these angles are subtended by equal arcs which have been described with equal radius and have equal chords (articles 42 and 111).

In geometry it is proved, that, if two straight lines as *D C* and *A B*, Fig. 79, are cut by a third straight line as *G C*, making the alternate angles *D C G* and *C G F* equal to each other, the two straight lines will be parallel.

Drawing through a given point a straight line parallel to another line may seem to be a matter too simple for bestowing upon it any particular attention; nevertheless, we strongly advise the student not to pass over this problem carelessly, but should study it carefully and commit it to memory, as this will teach him the best and only reliable method for drawing on the floor long parallel lines.

Directions.—In the space marked Prob. 7, draw a straight line, *A B*, which will be assumed to be the given line. This line should not be drawn parallel to any of the division lines. Above this line, mark off any point *C*, which will be the given point. Through this point draw a straight line parallel to the given line, according to the instructions given in Prob. 7.

Draftsman's Method.—If it is required to draw through a point a straight line, parallel to a horizontal line, the draftsman will use the T square, as explained in Art. 79 and illustrated in Fig. 47.

If it is required to draw straight lines parallel to vertical lines, the draftsman will use his set square in a manner as explained in Art. 81 and illustrated in Fig. 50.

If it is required to draw straight lines, parallel to oblique lines, that is, straight lines not horizontal or vertical, the draftsman adopts the following method:

Fig. 80 represents a given oblique line, *A B*, drawn on a sheet of paper; it is required to draw lines parallel to *A B*, according to the draftsman's method.

Place the T square with the set square in the position marked 1, in which the edge *c d* of the set square, when firmly held against the T square, will coincide with the given line *A B*. Now, with the left hand hold the T square in this position, and with the right hand move the set square along the edges of the T square, to any desired position, for instance, such as marked 2; then along the edge *c d* draw a line. This line will be parallel to the given line. In this manner any number of parallel lines may be drawn. Of course, in drawing these parallel lines, the set square must never be allowed to depart from the edge of the T square; the former must always be firmly held against the latter.

114. In connection with the last three problems the student will be benefited by reviewing the definitions given in the article 28 and all the following articles up to 46. In fact, to obtain a clear conception of the last three problems the student will do well by finding the answers to the following questions:

These answers may be obtained by referring to the number of the article given with each question.

What is an angle? Article 35.

What is meant by the vertex of an angle? Article 35.

What is meant by the sides of an angle? Article 35.

Can angles be designated, or, may we say, can angles be named by one letter, or must we use three letters? Article 35.

Under what circumstances can one letter be used for designating an angle? Article 35.

Under what circumstances must three letters be used for designating an angle? Article 35.

If three letters are used for designating an angle, which letter should be placed between the other two? Article 35.

What is an arc? Article 31.

What is a chord? Article 31.

The *Railroad Gazette* of Dec. 3, has information that 6,111 miles of new railroad has been built so far this year, against 2,523 miles for the corresponding period in 1885, 3,509 in 1884, 5,819 miles in 1883, and 9,574 miles in 1882.

Prof. Chas. I. King, Superintendent of the Department of Practical Mechanics, University of Wisconsin, at Madison, in sending a list of subscribers to the American Machinist, writes:

"We are only getting settled in our new buildings, but I have now 45 students in shop instruction, and think the number will reach 60 next term. We have a forge room with 10 forges; a moulding room; machine shop, 42x120; carpenter shop, 38x44; a room for patternwork, 30x30, and a room for instruction in use of bench tools for woodwork, 38x44. We hope by another year to have all of our appointments in first class shape."

Seymour's Pipe-Wrench Attachment for Monkey Wrenches.

This is a device which can be conveniently attached to a monkey wrench, converting it into a pipe wrench for small and moderate size pipe. Nothing is required to be done to attach it except to slip the attachment over the post of the wrench and screw up the movable jaw against it to hold it in place; the ends of the divided parts of the attachment are turned up to prevent attachment from being drawn out from between the jaws. The manner of using this device is so clearly shown in the engraving that further description is unnecessary.

The manufacturer is the Armstrong Manufacturing Company, Bridgeport, Conn.

Driving by fibrous ropes has been but little practiced in this country, although they are quite extensively employed in England. A recent example there is the arrangement of a 500 horse-power engine to drive a dynamo for 5,000 electric lamps, by ropes. The armature of the dynamo is 9 feet in diameter, the weight of the field magnets and frame being about 45,000 pounds.

The *Mexican Financier* gives a very satisfactory account of the use of steel rails in Mexico. Wooden ties are said to last from five to six years, and to cost about one dollar each. Steel ties cost, delivered, about two dollars each, and are expected to last from thirty to fifty years. The cost of spikes is saved when steel ties are used.

The following account of the breakdown of an engine which appeared in an English paper is equal to anything of the kind that ever appeared in a daily paper in this country:

A serious breakdown occurred last Saturday morning at the mill of Mr. T. Moss, Kirkham, resulting in the stoppage of the works for a considerable period. The accident happened to the new engine recently erected on the newest and most economical principle. The chief engineer when on duty heard a bumping of the engines. On going to the sluice valve to shut off steam he found that the vacuum had dropped in the valve and jammed it. On examination of the engines it was found that the piston rod, which runs the ball-thrust bearings, had become bent through one of the bearings becoming deranged. The links connecting the piston rod with the piston broke through, a bolt being eaten away by an accumulation of matter in the cylinder, which resulted also in a broken piston.

Water Purifier and Scale Extractor.

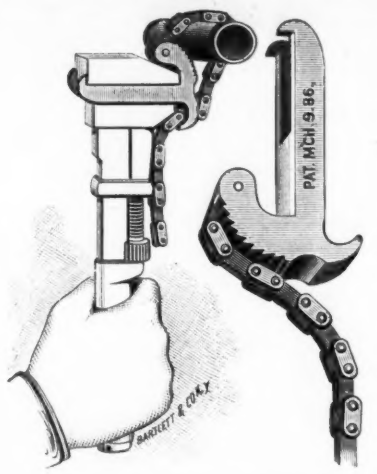
This device has for its object the getting rid of dirt and scale making impurities in water. In the engraving *A* represents the boiler, and *C* pans, set above the flues *B*. One of these pans is shown in the small engraving. *D* shows the over-flow tubes.

To the bottom from *E* a blow-off is attached to remove floating impurities. The feed water is supplied through pipe *K*, and overflows from one pan to the other, through the entire series. The pans cans be taken out and cleaned as often as is desirable. It is made by H. J. Delaney & Co., Milwaukee, Wis.

English Boiler Legislation.

Boiler makers and steam users in England are at present interested in a bill relating to the control of steam boilers to be introduced in the coming session of Parliament. It seems that explosions of steam boilers occur in England about as often as anywhere else. Some of the causes of these explosions are: Using boilers long after they are unsafe for any pressure; using safety valves which can be tampered with and overloaded, or even fixed down; using boilers without safety valves, and using unreliable steam gauges.

Here we see a rather bad state of affairs which the Act of Parliament is to rectify. It is expected that the bill will contain the following clauses, which may be classified as relating to three divisions of the subject: First, provisions for the complete registration



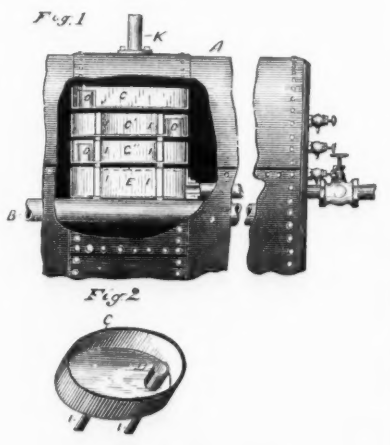
SEYMOUR'S WRENCH ATTACHMENT.

of all boilers at work at the time of the Act being passed, and those subsequently constructed; second, enactments as to the fittings with which boilers shall be provided; and third, provisions for insuring thorough periodical inspection of boilers by competent surveyors.

Lynde Improved Pop or Spring-Loaded Safety Valve.

Safety valves of the style shown on this page are made in variety of forms to suit every style of steam boiler, but are more particularly adapted to marine and stationary boilers. This cut is a representation of the stationary form. *A* is the valve; *B* guide wings attached to valve, and connecting the concave disc. *D* is the rim against which the guide bears, *E* the guide pin to the valve. *A C* is the nut by which, with the action of lever *J*, the valve is lifted from its seat when under pressure or otherwise. *H* is the pressure stud by which the valve is set to relieve at any pressure required. *I* is the check nut to make tight when the valve is set at the required working pressure, after which the valve can be locked, and the key held by the proprietor or some trusted person, thus avoiding all tampering with the valve, and insuring full security against overpressure in the boiler. The valve will open promptly when the pressure at which it is set is reached, thus reducing he pressure slightly, and never allowing it to increase if the valve is the proper size for the work it has to perform.

The cut shown here represents a new form of the Lynde valve, designed and constructed by J. E. Lonergan & Co., No 211 Race street, Philadelphia, Pa., who are the owners of all J. D. Lynde's patents on pop safety valves, and who are now manufacturing pop safety valves suited for marine, stationary, locomotive and portable boilers.



WATER PURIFIER.

The increased activity in locomotive building, and the prospects of having to build a number of large and expensive ships for the U. S. Navy, must indicate to the mechanic on this side of the Atlantic that the year 1887 will be a prosperous and profitable one to all; and particularly to those mechanics who devoted all their spare time during the past dull seasons to patient study and reading, increasing their stock of useful information, which will enable them to do more difficult work, and fill with credit to themselves positions of greater responsibilities.

We learn that John Fink, the bogus lubricating mixture man, has been arrested in Baltimore for swindling L. P. Whitman, Secretary of the Warren Glass Works Company, of Cumberland, Md. Fink has heretofore worked some dodge to escape whenever arrested. He has victimized quite a number of shrewd business firms with his recipe, and seems to be looking for more.

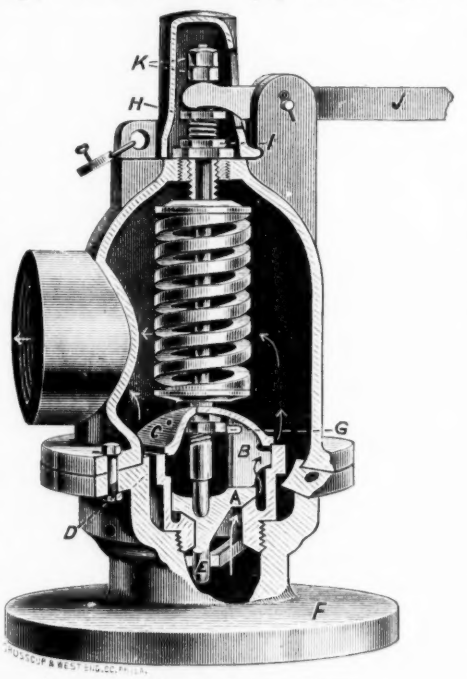
Boilers in Public Schools.

Steam boilers should be placed in the charge of competent engineers who have a license to do that kind of work.

This statement has often been made by many persons; is the opinion of every sensible man and woman, and according to the law of New York city, it should not be otherwise.

Yet why is it that in some of our public schools, boilers put in the basement of these schools are placed in the charge of janitors who are incompetent men, having no license for doing this kind of work? Do parents realize the danger in which their children are placed when attending schools of this kind? And do those in authority believe that the lives of children are of no value?

It is time that every person interested in the welfare of school children should be aroused, and have this state of affairs changed at once.



LYNDE SAFETY VALVE.

Trial of an English Compound Engine.

Tests were recently made at South Kensington, England, of a compound non-condensing engine, built by Davey, Paxman & Co., of Colchester. The high pressure cylinder was 12¼ inches, and the low pressure 20 inches diameter, with stroke of 24 inches. The engine is what is known in England as the semi-fixed, or under-type, called here semi-portable. The boiler is of the usual "locomotive" type used with such engines, the engine being located underneath and to the sides of the barrel. The boiler contains 100 tubes, 2¼ inches diameter, and 10 feet 7 inches long. The total heating surface is 711 square feet. The ordinary grate surface is 19.2 square feet, but was reduced for the trial to 15.3 square feet; smoke-stack, 17 inches diameter.

The engines were run at 104 revolutions, with an average steam pressure of 107 lbs. The admission of steam to the high-pressure cylinder was controlled by automatic cut-off governor. The cylinders are provided with steam jackets, but these were not in use during the trial.

The indicated horse-power was 109.5, almost exactly equally divided between the two cylinders. The consumption of coal per indicated horse-power per hour was 2 56 lbs. The water evaporated per pound of coal was 9.42 lbs.—equivalent to an evaporation of 11.33 lbs. from and at 212°.

Legal Decisions as Matters of Policy.

Edward Atkinson, of Boston, the well-known economist and the successful insurance manager, writes a letter to *Br dstreets* in which he says (referring to U. S. Treasury notes):

"The functions of money have been imparted to these notes by force of law, sustained by the decision of the Supreme Court, which will probably be reversed at a future day in order to avoid the dangers which may hereafter arise under the decision as it now stands."

Mr. Atkinson must have a very poor opinion of the nine eminent judges who constitute the Supreme Court of the United States. We feel assured that he is mistaken and that the Supreme Court does not render decisions as a matter of policy, but as a matter of law. There may be judges of minor courts that will give legal decisions to satisfy certain interests regardless of the plain requirements of law, but the masses of people in this country are not ready to believe any such prostitution of judicial power on the part of the Supreme Court. The decision Mr. Atkinson mentions was rendered eight to one, after mature deliberation, and nobody supposes that these eminent jurists have since become convinced that they made a mistake. If a real danger were apparent to the people of this country growing out of a decision of the Supreme Court on Constitutional law they would do as they did in the case of slavery—amend the Constitution.

There are two public dangers which should be fought against. They are the disregard of law by the "vicious elements," and the perversion of law by a certain class of wealthy men. The former breeds anarchists, and the latter monopolists.

A convention of those trades and occupations engaged in the machine industry of the United States was held last month in Cincinnati. We make some extracts from the address of the Chairman, J. E. Hall, delivered on that occasion:

"Of all forces that enter into the activities of modern civilization, machinery is the dominant force of all. It is true that machinery itself is dependent more or less upon all science, arts and trades; but there is no science, art or trade so universally and intimately associated with the general welfare as the construction and repairs of machinery. It is the important and deciding factor in every sphere of human activity. Agriculture, mining, transportation, both land and water, manufacture, education, finance, sanitary science, and war, all seek to possess or control this great umpire in the struggle for supremacy. We may safely say, that without machinery—education, freedom, democracy, would have remained mere idealism in so far as the masses of people are concerned; and its influence in conserving public morals, is incalculable, for machinery has made possible those opportunities whereby human veins may be something higher than mere animals, whose daily routine of drudgery and toil but scantily administers to their physical necessities. Through the instrumentality of machinery mankind is afforded that leisure so absolutely necessary to develop those innate capabilities for progress that distinguished them from the brute creation."

We note that the Pennsylvania legislators who must soon travel to Harrisburgh are disturbed over the possibility that the Attorney-General may declare the granting of free passes by railroad corporations illegal. It is said that large railroad corporations in several States are engaged in a question of arithmetic as to whether they get an equivalent, in the way of legislation, for the passes they issue to lawmakers.

Modern Locomotive Construction.

By J. G. A. Meyer.

Thirty-First Paper.

PRACTICAL APPLICATION OF THE PRINCIPLES RELATING TO THE VALVE MOTION.

In our previous papers we have endeavored to explain the manner of laying out on paper a simple valve gear, so that its mechanism can be correctly proportioned, drawn, and made in the shop.

After the different parts of the valve gear are finished, they must then be correctly set in the engine. The principles involved in the practical setting of the valve gear are the same as those presented in connection with laying out the valve gear given in the previous papers, but, as will be seen hereafter, the method employed in the shop for finding the position of the eccentric on the shaft, also for finding the correct length of eccentric rod, is not the same as the method employed in the drawing room for obtaining the same results.

In setting a simple valve gear as illustrated in Fig. 170, the great aim is to obtain equal leads of the slide valve; to obtain these we must first determine the correct length of the eccentric rod; second, find the locations of the dead centers of the crank; and lastly, the correct positions of the eccentric on the shaft.

In order to show clearly the practical method employed in setting the valve gear in an engine, we will take the following example:

Example 35.—The distance, as shown in Fig. 170, between the center of the crank shaft and the center of the cylinder is 8 feet 4 inches, the length of the valve rod from center of valve to center of valve rod pin is 20 inches, lap $\frac{5}{8}$ of an inch, lead $\frac{1}{16}$ of an inch, and travel of the valve 5 inches. In this example it must be understood that the cylinder, shaft, and the other parts of the engine have been correctly set in line, and that all we have to do is to set the valve gear.

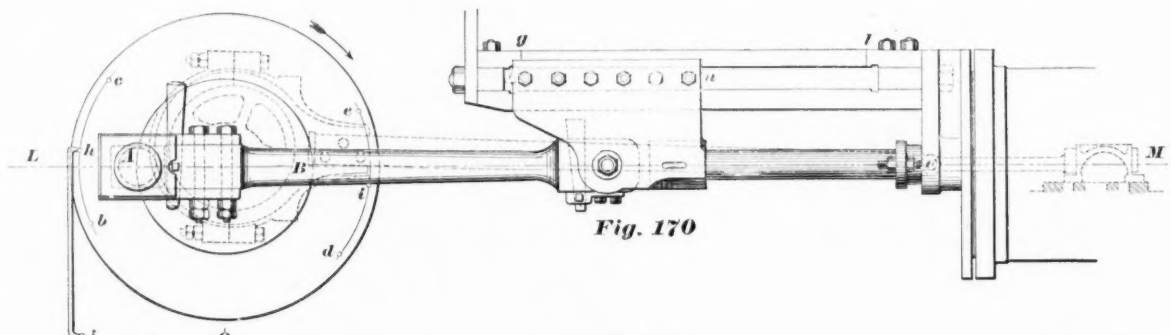


Fig. 170

Fig. 171

LENGTH OF ECCENTRIC ROD.

Our first duty is to find the length of the eccentric rod; on paper this can be easily accomplished. Here we have only to draw the valve and rod in the center of its travel, and measure from the center E of the valve rod pin to the center of the shaft which is equal to 100—20=80 inches, and this distance of 80 inches is the length of the eccentric rod.

Now if the workmanship of all the other parts of the engine is absolutely perfect, so that all the dimensions of the mechanism are absolutely correct, all that we would need to do, is to make the eccentric rod from the center of the eccentric strap to the center of the valve rod pin 80 inches long. But such perfect workmanship is seldom procured, and therefore the eccentric rods are generally made of two pieces, namely, the eccentric strap and the rod proper, and constructed so that the distance between the center of strap and the center of pin E can be adjusted to suit the other parts of the machinery, and thus enabling all to work harmoniously and correctly. (See twenty-sixth paper.)

To obtain in an engine by measurement the distance from the center of shaft to the center E is often a difficult matter if not impracticable, and therefore the following practical method for finding the correct length of the eccentric rod is employed.

Fasten the eccentric on the shaft in a position which will allow it to be connected to the valve rod. In fastening the eccentric in this position, no attention need or should be paid to the position of the crank; but we should proceed without taking the crank into consideration. Place and connect in position the eccentric rod, which we will assume to be somewhat short, turn the crank shaft in a direction in which the shaft is designed to run, and when the valve arrives in the position marked 1, drawn in full lines, Fig. 171, which is one extreme end of its travel, draw along the edge a of the valve, a line on the valve seat; again turn the shaft in the same direction as before, and when the valve arrives in the position marked 2, shown in dotted lines, and which is the other extreme end of its travel, draw along the edge b of the valve, a line on the valve seat. Also on this surface draw a short line d midway between the lines a and b and parallel to the same. The distance from the line d to the center e of the valve seat indicates that the length of the eccentric rod is just that much too short and must be increased by an amount equal to this distance. If this measures $\frac{1}{4}$ of an inch the length of rod must be made $\frac{1}{4}$ of an inch longer. Again, if the point d had fallen on the other side of the center e of the valve seat, then the distance between d and e would have indicated that the eccentric rod is just that much too long, and must be shortened by an amount equal to this distance.

In the eleventh paper we find that when a valve has no lap the center of the eccentric is placed in a line perpendicular to the center line of motion, and in the twelfth paper we find that when a valve has lap the angular advance of the eccentric must be laid off from this same line. Therefore in Fig. 171, the angular advance of the eccentric must be laid off from the line $O\ P$ drawn perpendicular to the center line of motion $L\ M$. Consequently, on paper, the position of the eccentric is easily found, for, we have only to draw a circle whose diameter is equal to the travel of the valve, namely, 5 inches; and a straight line $f\ m$ parallel to $O\ P$ and $\frac{11}{16}$ of an inch (which is equal to the lap and lead) away from it. The point f in which the line $f\ m$ intersects the circle is the center of the eccentric when the crank is at L and the crank shaft is to rotate in the direction as indicated by the arrow. But in setting the valve gear in an engine, lines like $L\ M$ and $O\ P$, from and on which measurements can be taken, would be a difficult matter to locate, and therefore we must seek another method, but not new principles, for laying off the angular advance of the eccentric.

With a little reflection it will be seen that, since we have the correct length of the eccentric rod, we can lay off the angular advance from the center E, Fig. 170, providing we first assign some particular position to this center, and the best position that can be assigned to the center E for this purpose is the position which corresponds to that of the crank when the latter is on a dead center; for instance, such as A, Fig. 171.

TO FIND THE DEAD CENTERS OF THE CRANK.

The dead centers A and B of the crank pin, in Fig. 170, are represented by the points in which the center line of motion $L\ M$ intersects the circumference of the circle representing the path of the center of the crank pin. But, as stated before, we cannot locate in the engine the line $L\ M$; we must, therefore, in this case also adopt a practical method by which these dead centers can be readily and correctly found. For the sake of simplicity in our illustration we have represented a crank disk instead of a locomotive wheel. This will not affect the correctness of our reasoning, for what is true in one is also true in the other case.

On the crank disk describe arcs $b\ c$ and $e\ d$; if the periphery of the disk is turned then the arcs $b\ c$ and $e\ d$ can be described with the aid of a gauge; if the periphery is not turned then these arcs should be described with the aid of a scriber or sharp-pointed instrument held against the face of the disk while the shaft is revolving in its bearings; but whichever way the arcs are described these must true. Next turn the shaft in the direction of the arrow, until the crosshead is within a short distance from the end of the stroke, say $\frac{1}{2}$ of an inch; while in this position mark on the slides a line g even with the end k of the crosshead. Also while the shaft and the crosshead is in this position place a center-punch mark j on the frame or any other fixed surface. From this point j as a center, and with a tram of any convenient length, $j\ h$ as a radius, describe a short arc intersecting the arc $b\ c$ in the point c (this point c will at this instant lie under the end h of the tram, and not as shown in the figure). Now turn the shaft in the same direction as before, causing the crosshead to complete its full stroke and part of the return stroke, and when during this motion the edge k of the crosshead touches the line g on the slide, stop turning the shaft, and while in this position describe from the point j as a center and with the same tram as before, a short arc, intersecting the arc $b\ c$, in the point c. Find the point h on the arc $b\ c$, midway between the points b and c. Now turning the shaft into a position in which the ends of tram will touch the points h and j, the crank will be on one of its dead centers, as shown.

In a similar manner we can find the point i; but for this purpose we must draw another line, l, on the slide, which is drawn even with the edge n of the crosshead when it is within one-half of an inch of the beginning of the front stroke. Then from the point j, and with the same tram, and in the same manner as before, the points d and e are found, and the point i, midway between these points on the arc $d\ e$, is established. Turning the shaft into a position in which the tram will lie on the points j and i, the crank will be on the other dead center.

TO FIND THE ANGULAR ADVANCE OF THE ECCENTRIC.

We have stated that the angular advance of the eccentric can be laid off from the center E, Fig. 170, when this center is in a position corresponding to that of the crank when the latter is on a dead center. Consequently, turn the shaft so that the crank will be on the dead center A (B would answer the purpose just as well), and while in this position move the eccentric on the shaft in a position which will give the valve the required amount of lead, that is, one-sixteenth of an inch; by so doing we bring the center E in the correct position when the crank pin is at A. But since the length of the eccentric rod is now correct, the eccentric must now be moved in a position on the shaft in which the eccentric rod can be connected. Fasten the eccentric in this position. If no inaccuracies exist in the valve gear, then, by turning the crank shaft, we will find the same amount of lead when the crank is at B. If the valve has not the same lead at each end of the stroke, then inaccuracies do exist, which must be found and rectified. In setting the valve extreme accuracy is necessary, without this, failure will be the result.

Suggestions in Machine Design.

By A. J. Shaw.

I.

The following articles are the outgrowth of the writer's experience at the drawing board and in the shop, and are presented with the hope that they may be a means of leveling for others some of the difficult paths to traverse which has cost him much thought at times, and prevent to some extent a repetition of errors which have cost others money.

The treatment is necessarily general rather than special in most instances, for, as nearly every design is a special one, or belongs to a special class, which must be considered by itself, a study of one, or of a number even, no matter how exhaustive, might evolve nothing of value in another case.

It may seem that in some respects the survey is rather from the speculative than from the directly practical standpoint; but this is thought to be of use in that it affords a broader view of the subject involved.

All design is imitative to this extent—no combination can be conceived the elements of which are not first known.

It is impossible for the human intellect to imagine anything which is totally foreign to its previous experience. Even in our dreams, in which are embodied the wildest and most incongruous images and combinations, the dream as a whole is composed of parts, which, as isolated details, we have seen or of which we have heard, in our waking hours.

In the same way, the most strikingly original invention, while it may be based on principles of which we had had no previous knowledge, is, in its material embodiment, made up entirely of elements already known. In its construction it is but a collection of shafts, cams, gears, levers, screws, etc., which are already familiar in other combinations.

Words are a necessity to clearly-defined thought. It is only in the realm of music that there seems to be any exception to this, and even there it is not so much a clearly-defined thought as an emotion which seeks expression.

Details are to the mechanician what words are to the poet—the media for the expression of his ideas; and it may be as difficult for the inventor to conceive clearly that for the realization of which details do not exist, as for the poet to imagine definitely that for the expression of which language has not yet been created.

Some machines seem to exist because they are—they were not born, neither did they grow—they happened.

Our judgment of a machine is apt to be influenced largely by things which, while they have no relation to its efficiency as a piece of mechanism, are indicative of the manner of design and construction.

When we see brackets, levers, gear arms, of a cross-shaped, ribbed and oval section, on the same machine, with no apparent reason for the difference, we cannot feel that the machine is as good as if the unities of design had been preserved throughout.

We are apt to think that it was a victim of circumstances, and had been collected by installments.

This is the case with nearly all machines built on the cut-and-try system; they may do their work, but from the mechanico-esthetical standpoint they are horrible.

There is a well known upright drill in the market which will illustrate this point.

It is a finely-designed machine in many respects, well arranged and proportioned, the curves well blended and true, the sections of cast-iron parts all circles or well-shaped ovals. But on the side of the column is bolted a bracket for carrying the shipper lever, added, evidently, at a date later than that of the original design. In elevation the

bracket is a clumsy ogee, of a T section, with the rib at one end on its upper, and at the other end on its lower side, making as ugly a combination as can well be conceived.

The machine, as a whole, reminds one of a dress suit and cowhide boots.

Each detail should be to the machine as are the branches of a tree to the trunk, a natural outgrowth.

All design is a compromise between commercial and engineering requirements—the first demanding something cheap, the second requiring that that something be good.

In constructing for the market, the constant effort is to lower the cost of production.

This may be done legitimately in either one or both of two ways: Improved shop methods, or better design; illegitimately, by lowering the standard of quality below what it should be.

While it is not a new idea, it is not sufficiently realized that the too great cost of many machines is due to the fact that the question of "how shall this piece be made?" was not carefully enough considered in relation to each one of the individual details.

There is a constant tendency with the designer to become careless in his consideration of methods of construction; to design the machine as he wants it, and let the shop devise the way in which it shall be built.

In cases of doubt, do not hesitate to go to the foremen, or when discipline permits it, to intelligent men in the shops for advice.

If this were done more frequently it would save not only time and money, but tend toward a more cordial feeling between the shops and the office than usually exists, at present, in most places.

Those designers who do not consult the shop, either from a feeling of superiority, or because they do not like to make an acknowledgment of ignorance, are apt to be the ones who have most need of it.

Differences in a machine, so slight as to seem at first glance quite insignificant, may make a considerable difference in cost, and entirely change the manner of construction.

But however careful and conscientious the designer may be in his consideration of shop methods, it will nearly always be the case that the actual processes of construction will develop many points for improvement; and if he has watched his work through the shop with any degree of care, he will find many details the cost of which may be lessened without any decrease of efficiency, and with but little if any alteration in the general appearance of the machine.

A careful study of the facilities for doing work in the shop where the machine is to be constructed, may be an important factor in keeping down the cost, and will usually exert a considerable influence on the character of the design.

So designing work that it must be done by unusual methods should be avoided unless there are good reasons to the contrary.

Man is an automatic machine, himself, to a certain extent, and operations to which he is accustomed are performed more quickly, other things being equal, than those with which he is unfamiliar.

Work which can be laid out and done by the usual methods goes on as a matter of routine; but when an operation is entirely out of the ordinary course, to the time actually required to do the mechanical part of the work, must be added that expended in conveying and receiving instructions as to the methods to be employed.

This includes not only the time of the workman, but of the foreman, and oftentimes of the designer.

If, however, a considerable number of pieces are to be made, the objection of unusualness has little if any weight; the principal question then being as to the relative value of the methods in themselves.

Sometimes the only remedy for excessive cost is an entire re-designing and general simplification of the whole machine.

There are cases in which the most effective method is to abandon the original construction and build on a new foundation.

Occasionally the surest thing is—not to build the machine at all.

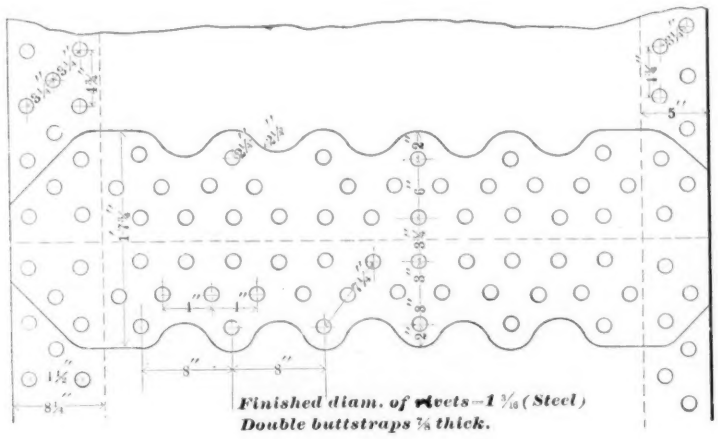
This is a heroic measure, and hurts.

It is in the nature of a criticism on the original design.

The best thing is not usually the cheapest, but the cheapest thing is sometimes the best.

It is usually accepted that when one wants a good thing, he must pay for it; and it is undoubtedly true as a rule, but how often have we seen that which we have been employing a whole tangle of expensive machinery to do, accomplished in such an absurdly direct and simple manner that we can only wonder why we did not think of that at once.

He who makes one piece to accomplish that which formerly required two, is—like him who causes two blades of grass to grow instead of one—a benefactor.



LETTERS FROM PRACTICAL MEN.

Steam Boilers.

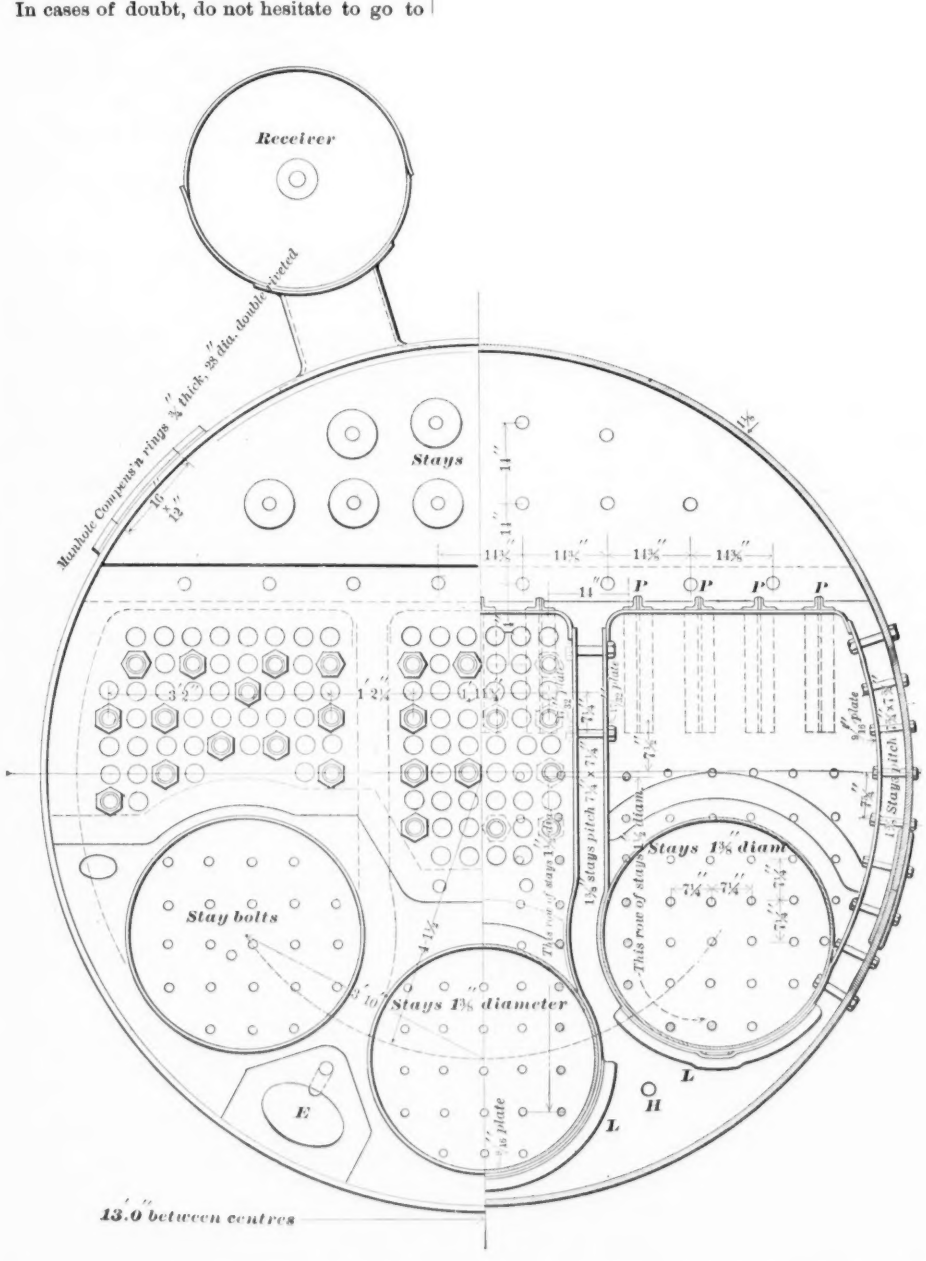
Editor American Machinist:

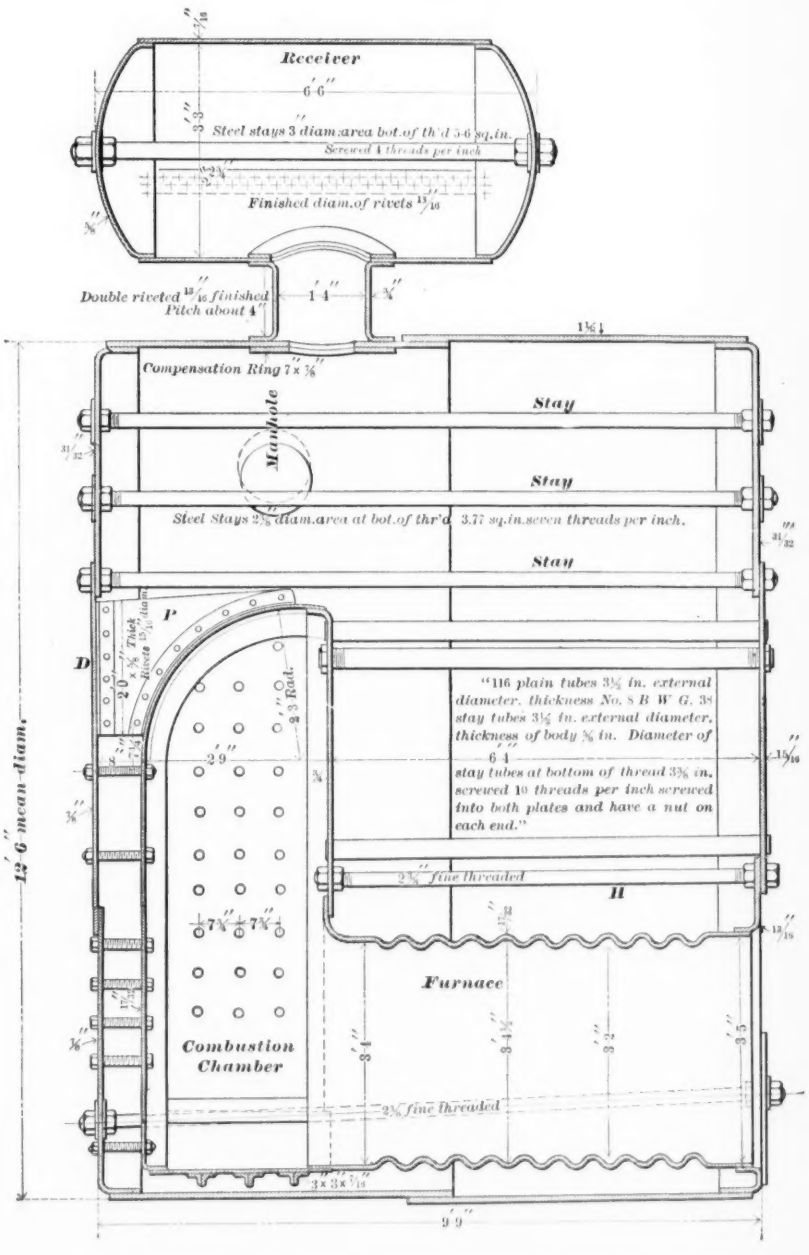
Among advanced engineers the mysteries in boiler explosions have disappeared; the theories that steam under the temperature it attains in a steam boiler, turning, under some inexplicable conditions, to a "blue gas," and that water assumed a spheroidal form and suddenly flashed into steam, having been relegated to the traditions of the past.

"When a boiler bursts, it is simply because it was too weak to withstand the pressure," is a truism that is often heard, but that simply begs the whole question, because it leaves open the question whether the boiler was too weak to withstand its intended working pressure, or the pressure was greater than the boiler was intended to withstand. Like everything else in mechanical structure, the boiler question is very largely a commercial one, because we know positively that we can build a boiler that will withstand with safety any working pressure employed in ordinary practice, providing the purchaser will pay for the cost of proper construction.

We can also, under an intelligent system of inspection and repair, maintain a boiler in safe working condition, and know positively that it is in safe working condition

The fact of the matter is that boilers have been constructed in a general way upon the "cut and try" system, instead of upon a strictly engineering basis, the actual strength having been an indefinite quantity, and not held as being of much importance, as long as




Receiver
6'-6"
Steel stays 3 diam. area bot. of thr'd 5.6 sq.in.
Screwed 8 threads per inch
Finished diam. of rivets 15/16
Double riveted 15/16 finished
Pitch about 4"
Compensation Ring 7" x 3/8"
Stay
Manhole
Steel Stays 2 5/8 diam. area at bot. of thr'd 3.77 sq.in. seven threads per inch.
"116 plain tubes 3 1/4 in. external diameter, thickness No. 8 B W G. 38 stay tubes 3 1/2 in. external diameter, thickness of body 3/8 in. Diameter of stay tubes at bottom of thread 3 3/8 in. screwed 10 threads per inch screwed into both plates and have a nut on each end."
Furnace
Combustion Chamber
2 3/4" fine threaded
12'-6" mean diam.
9'-9"

it was sufficient to withstand the test-pressure or proof strain. A person or a firm may have a right to follow the cut and try system in cases where their own interests alone are at stake; but where the property and lives of others are at stake, no such right can be admitted. From an engineering standpoint, we may take the ground that a boiler should be a perfect structure, as nearly as possible equally strong in all parts (with the reduction of strength due to corrosion, etc., taken into account), even though such a construction may involve extra expense in the manufacture of the boiler.

One of our greatest misfortunes in this matter has been the idea prevalent among many, that anybody could build a boiler, and hundreds of boilers have been built upon this basis while following in their wake have been a train of so-called mysterious explosions.

Confidence in a structure has no weight or foundation unless it is intelligent confidence, or in other words is based upon actual knowledge of its strength and its load.

In a small boiler the problem is comparatively simple, but when we come to large boilers and especially large marine boilers of high pressures, boiler construction calls for a high order of engineering knowledge and ability.

A sixteenth of an inch more or less of thickness in the shell of a boiler, say 42 inches in diameter, is of comparatively little moment, and a maker may say to himself: "I will punch the holes and use a plate $\frac{3}{8}$ instead of a $\frac{5}{16}$ inch thick, so that the back will be amply strong enough for the pressure, even though the riveted joint has only 55 per cent of the strength of the solid plate." But if the constructor of a 12-foot marine boiler to carry 160 pounds per inch proceeded upon any such a theory he would find that his vessel was carrying a load of unnecessary dead weight that only served to increase the first cost of his boiler and to weaken it and hasten its destruction.

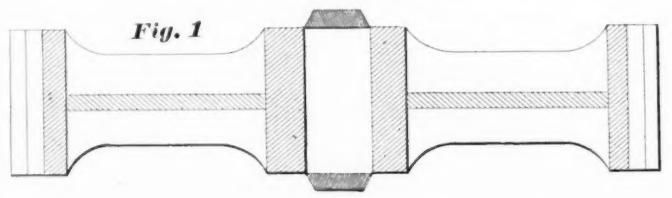
In the illustrations herewith we have an example of a modern marine boiler to carry 160 pounds working pressure and built to meet the requirements of the English Board of Trade. Thus the stays are nutted on both sides of the plate and have a washer beneath the outer nut. Stay tubes are employed, being threaded and nutted on the outside. Gusset and not girder stays are used, and I believe it can be shown that all these features are essential to proper boiler construction, and that the objections to their use advanced by some will not bear intelligent investigation.

In the matter of the stays and tube stays their extra expense is sometimes urged against them, but we may look at this matter in two ways; first, at the extra expense of threading and nutting, over that of riveting, and second, at the amount of this extra expense considered with relation to the extra strength this construction gives to the whole boiler; the latter is the sound engineering view to take of the matter. If a boiler of a certain strength and degree of safety costs $5,000 and its value in the above respects can be increased 5 per cent. at a cost of $10, then the $10 is well invested, even though it were supposed that the extra strength was never called into active service. But the extra strength will always be called into active service as the boiler wears, prolonging its life, providing against disaster, and tending to maintain its capability to carry the pressure it was originally designed for.

In boiler construction we may proceed upon one of two lines; first, we may look upon the boiler as a structure of varying strength in different parts, with the weakest part strong enough for its duty, and the whole boiler good enough to pass for insurance or other purposes; and second, we may look upon it as a structure that is to last a certain length of time and be kept up to a certain standard, so that when it is worn out, or its pressure reduced, it shall, as far as possible, occur from a general decay, and not local decay. The weight of the boiler depends mainly upon the thickness of shell, the strength mainly upon the form and method of constructing the riveted joints and the staying, the durability mainly upon the quality of the material, the workmanship, the design, careful usage and proper repair, and the safety upon proper design and inspection. By proper design I mean not only the form and proportions of the various parts of the boiler, but also upon the designer knowing exactly and precisely what duty each part has to perform, and that it will perform this duty under all conditions of actual use. Just as soon as a designer assigns a value to some one part, that he knows is a variable value, and that may under certain and not unusual conditions cease to exist, he is departing from sound practice, and a boiler is of all things in the world the most dangerous piece of mechanism to trust to luck upon.

The staying power of a tube is a variable quantity, a quantity that may and often does cease to exist, and the Board of Trade rules are right. They never have and they never will allow an ounce of working pressure for the staying power of a tube, unless it is a stay tube.

Fig. 1



As this letter is now, however, already long enough, I will reserve further remarks upon this point for another communication.

JOSHUA ROSE.

Making Narrow-Faced Spur Gears from a Wide-Faced Pattern.

Editor American Machinist:

The following plan is for making a narrow faced gear wheel from a wide-faced pattern. In this instance it is assumed that a wheel with 6-inch face is required from the pattern, Fig. 1, of 8-inch face, the arms to be in the center.

First bed the pattern in keeping top of teeth one-inch above the level of the floor. Now, ram up the outside with black sand to the top of teeth, then ram the inside, tucking facing sand under the arms in the usual way. Get strips of wood 1″x2″, place them on the web between the arms, ram up to the top of them and strike the joint off, which will be one-inch above the web. Make the joint on outside level with the top of teeth. Ram up the cope, put pins in between arms to take the vent off. Drive the stakes in corners as straight as possible. Having lifted the cope off and set it aside you now strike off the one-inch of sand that is above the web between the arms, swab and vent under the arms, then dig around the outside to bottom of the teeth, loosen and draw the pattern up one-inch, slip four blocks one inch thick under the teeth to hold it up. Ram in facing sand under and up to bottom of teeth, then draw the pattern, take out the blocks and fill the four spaces up level. Raise the print at the hub one-inch and ram it up with facing sand, and strike it off level with top of print. You then ram sand in bottom ribs of arms a little more than one-inch. Place the pattern back and knock it down until solid all around the bottom of teeth; you now ram up the teeth with facing sand within 2″ of the top of teeth, and put nails or rods in if required. Get a strike made as shown in Fig. 2. Strike the joint off all around the wheel. Hold the strike well down on top of teeth; slick it smooth between the teeth.

The pattern is now 2″ above the joint on the outside of wheel, which allows for the one-inch you have cut off the bottom and also the one-inch the cope will drop by the cutting off the one inch of sand that was above the web between the arms. You now draw the pattern and finish the mould; try the cope off, see that it touches all around.

The above is the best method I know of; for such a job; care must be taken in cutting the hub core 2″ shorter than the pattern, as a moulder is apt to forget that the cope drops one inch. In large wheels where you have to lift the sand between the arms with plates, you cut the one inch off the top ribs after the cope is lifted.

PETER CAMPBELL.

ARLINGTON, N. J.

Casting Chains.

Editor American Machinist:

In an elaborate and valuable report on the progress of mechanical engineering, read before the Civil Engineers' Club of Cleveland, November 23, 1886, by Mr. Joseph Leon Gobeille, the achievement of manufacturing weldless links was brought up, and a model of a mould for casting chain, seen in figures 1 and 2, presented. *A* shows the first link being held by the mortice block *B*, in position for the second link to be cast in the mould *C*, through the gate or opening *D*, after which it is removed and placed as *A* now is, and another link is then cast, the process being repeated until the length of chain desired is obtained. With this mould Mr. Gobeille said he could cast five links in one minute, and to prove to the members present that the plan was practicable, he presented quite a long chain made of lead, the mould in which it was cast being a wooden one.

Fig. 2

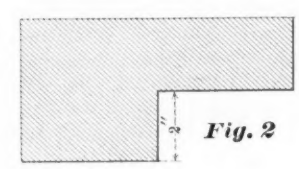


Fig. 1

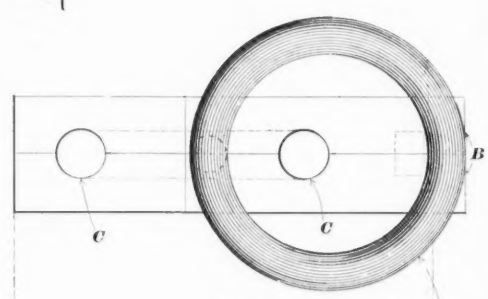
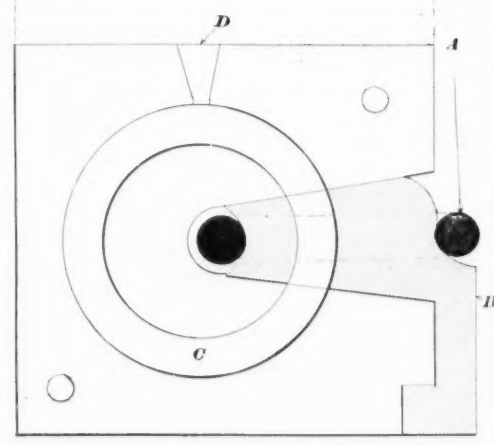


Fig. 2



CASTING CHAINS.

While the form of link shown is round, it will, of course, be evident that oblong or almost any other form of a link could be cast. For long links where there would be trouble expected from contraction with strong metal cast in an iron mould, the writer can conceive how a sand center could be used to allow freedom for contraction, and no doubt others can conceive the same.

THOMAS D. WEST.

Getting Steam Out of a Mine.

Editor American Machinist:

D. H. L. asks in question 411 how to get rid of the exhaust in the mines, on account of the unpleasantness of steam.

You tell him to attach a special condenser. I will tell you what I saw in Wyoming about fourteen years ago. The Rock Springs coal mine had a Cameron pump with about a four inch discharge to keep the water out of the mines. The boiler to the pump was on the surface, and the pump was over three hundred feet away. A few feet below the pump there was a tee in suction, and one branch ran a few feet to what the miners called a sump, and the straight pipe ran about eighty feet further to another sump. Each pipe had a stop cock to regulate flow, and the pump drew from bottom at once. The exhaust was run into the sump near the pump, and the water allowed to cover the end of exhaust pipe about four inches, or enough to keep the exhaust from opening the water and escaping into the air. The height of water in pipe was regulated by the stop-cocks, and the water ran in fast enough so that the temperature was raised but a trifle.

This arrangement seemed to work good, and as the pump only made about 75 or 80 revolutions per minute, the back pressure was slight.

FRANK HILL.

Dallas, Tex.

The New York Meeting of the Mechanical Engineers.

ABSTRACT OF PROCEEDINGS.

Professor Baker (England) submitted a paper: "Some Notes on the Working Stress of Iron and Steel," from which we make the following extract:

Few engineers of experience who have had to deal both with machinery and with structural iron work, such as railway girders, can have failed to note inconsistencies in practice, and general vagueness as to the meaning and use of such terms as safe working stress or factor of safety. Rankine defines factor of safety as the ratio in which the ultimate strength exceeds the working stress, and assigns to it the value of 4 to 6 for ordinary steel and iron subject to a variable load. But if we consider for a moment how the proportions of almost all parts of a machine, from the axle of a country cart to the coupling rod of an express engine, have been arrived at, we shall see that it has been by the gradual strengthening of the parts which had proved by accumulated experience to be too weak, and not by calculating the dimensions on the basis of a factor of safety of 4 to 6.

To illustrate this fact we cannot, indeed, select a better example than that of the coupling rod of a locomotive engine. Thirty to forty years ago the coupling rods in general use were round rods about $2\frac{5}{8}$ inches in diameter at the center and a trifle smaller at the ends. They were next changed to flat rods about $3\frac{1}{2}$ inches deep by $1\frac{1}{2}$″ thick, and subsequently the dimensions were modified to 4 inches by $1\frac{1}{4}$ inches. Finally, we have now on many railways girder section rods $4\frac{1}{2}$ inches deep, $2\frac{1}{4}$ inches wide over the flanges, and $\frac{7}{8}$ inch thick in the web. Why were the successive modifications introduced? Obviously as the result of experience, and not of calculation, or of increased power in the engines. The sectional area at the center of the round rod was 5.4 inches; of the first mentioned flat rod 5.25 inches; of the second 5 inches, and of the last 6.4 inches. In no case would the direct stress on the rod, even assuming all the power of the engine were transmitted through it to the coupled wheels, exceed 6,000 lbs. per square inch; therefore direct stress had nothing to do with the alterations. What happened was this: Failures occurred with the round rods, and some shrewd, practical man instinctively concluded that the fracture occurred from transverse stress, and altered the section to a deep flat bar better able to resist bending. Theoretical considerations show the justice of this conclusion. At a speed of 50 miles an hour, the stress on the round coupling rods of an old type Great Western Railway engine, the writer finds, must have been 14,500 lbs. per square inch from centrifugal force alone, or say, 17,000 lbs., including the direct stress from the engine. This stress has since been gradually reduced until with the most modern girder section rods, the combined stress from centrifugal force and steam pressure does not exceed half of the above, or 8,500 lbs. per square inch.

Now, what is the factor of safety in the latter instance? Under direct pull the coupling rod would stand an ultimate stress of say 50,000 lbs. per square inch; under direct compression, say 20,000 lbs.; and under transverse stress, which as we have seen is the one determining fracture, the calculated

ultimate stress on the extreme fibers would be about 80,000 per square inch. Is the factor of safety here

$$\frac{80,000}{8,500}=9.4, \text{ or is it } \frac{17,000}{8,500}=2?$$

Experience has shown that the coupling rods are sure to fracture ultimately if the stress reaches 17,000 lbs. per square inch; and the writer's experiments, to be hereafter referred to, point to the same conclusion. By making the working stress half the breaking stress as determined by actual practice, adequate security is found to be attained.

The Conway (railway) tubular bridge, 412 feet span, was instanced by Prof. Baker. In this bridge the factor of safety was but two or two and one-half, yet 36 years' use had given no indications that it was too low. But experience had shown that with small span, and light girders, such stresses would rapidly lead to destruction. Whether a coupling rod for a locomotive or the bridge over which the locomotive runs, the engineers have learned by experience the important truth that the strength of a structure or piece of mechanism cannot be determined by the simple process of breaking a piece of the material in a testing machine, but must be ascertained either by the gradual accumulation of the results of actual working, or by testing the material under conditions as far as possible, analogous to those obtaining in the case under consideration.

The author then describes a large number of experiments relating to the "fatigue" of metal. These experiments showed that, in accordance with experience, pieces subjected to such strains as screw shafts and axles when made of a fine quality of high tension steel, were not practically nearly as strong as if made of soft steel, having theoretically but little more than half the strength of the high grade steel. Says the author: "It is impossible, in the face of results such as these, to contend that the ordinary laboratory tests of a metal give any adequate measure of its value as a material of construction."

The experiments referred to show the destructive effects of alternating stresses. Thus in one instance an alternating stress equal only to one-seventh of the static breaking load, broke the bar.

This, as the author concludes, is "a sufficiently remarkable result." The conclusions are important as relating to the strength of parts of machines; other experiments showed that alternating direct strains, as in connecting rods, were equally destructive.

The conclusion of this paper is as follows:

"In concluding this necessarily very hurried and imperfect paper, the writer would like to bear testimony to the admirable behavior of a very good friend of his—mild steel. During the past three years he has had to deal with about 24,000 tons of that material, and to submit it in many cases to very harsh treatment. He has had more cases of so termed "mysterious fractures" with the few tons of wrought iron, used for certain temporary purposes, than with the whole 24,000 tons of steel. This result of his experience may be of interest to brother members of this Society who now are, or will doubtless be, large users of mild steel; and the testimony is perhaps of the greater value as the work at the forth is pressed on day and night, and no precautions are taken which would not equally be necessary, were the material the highest class of Lowmoor iron, costing double or treble the price of the steel."

"Recent Improvements in Dredging Machinery," was the subject of a paper by A. Wells Robinson. In it the author argues in favor of the endless bucket machine as against the dipper machine. Buckets used coupled directly to each other, instead of separated by a link, are referred to.

The writer also favors cast-steel buckets made of a single casting.

He concluded that the dipper machine will require about twice the power to operate, the material removed being the same, that the endless bucket would. Means of preserving the pins and analogous parts from the rapid wear from sand and dirt were described.

In discussing this paper, Mr. Towne called attention to the fact that the endless bucket machine was used many years ago in this country, but some how while it showed, theoretically, a saving in power as compared with the dipper machine, this saving did not appear to obtain in practice. He thought the dipper dredge the best for most purposes.

A paper by William Cowles on "Fire Boats" gave some interesting accounts of their construction and use.

So far as the writer knew, the first floating fire engine—self-propelling and of high power—was the Seth Low, of the Brooklyn Fire Department, built in 1885. Previous to this there had been several fire tugs built; but with one exception—the Zophar Mills, of New York—they had but little pumping capacity. Since the building of the Seth Low, two other boats, somewhat similar, had been built, in which some improvements were made. One of these was built for Cleveland, and the other—the Geyser—for Chicago. The author compares the Geyser with the Merryweather, built in London in 1886. The reported capacity of the Merryweather, he says, is a single $1\frac{3}{4}$ inch to 2 inches stream, thrown 200 feet. The capacity of the Geyser, he concludes, is eight to ten times as great. The Merryweather has two pumps, cylinders 7″x24″, driven by two steam cylinders, 9″x24″; the Geyser has four pump cylinders, 9″x10″, driven by four steam cylinders, 17″x10″.

Fire boats, the author thinks, are by far the cheapest fire engines for protecting water front and shipping, and can, by the great power of their engines, work through long lines of hose, reaching back from the docks. Or in case of scarcity of water, they can supply shore engines, either pumping into a tank, or the shore engines can connect their suction direct to the delivery from the fire boat.

A paper by Professor Thurston "On the Friction of Non-Condensing Engines" begins as follows:

The assumption of the distinguished engineer, De Pambour, that the wasteful resistance of a steam engine consists of a constant quantity, the friction of the unloaded engine, increased by some increasing function of the added load, has been accepted as correct by probably all recognized authorities since his time.

The author then goes on to show from the result of experiments with two straight line engines, that this is not true, at least of modern high-speed non-condensing engines, but that the loss from friction, although not quite, is nearly constant through a wide range of load. The following conclusions are drawn:

(1.) The friction of the non-condensing engine, of the class here described, is sensibly constant at any given speed, at all loads, and is at different speeds entirely independent of the magnitude of the load.

(2.) The friction of engines, of the type described, is variable with variation of speed of engine, increasing as speed increases, in some ratio as yet undetermined, but probably different with every engine, and for the same engine with every change of conditions of operation.

(3.) The friction of engines increases with increase of steam pressure, in the case of the class here referred to, in a probably similarly variable manner with that observed with alteration of speed, neither method of variation being capable of representation by any convenient algebraic expression.

(4.) The total resistance measured at the piston of the engine is composed of two parts, the one sensibly constant at the working speed, the other variable with external load.

The concluding portion of the paper is in explanation of why the results given obtain, and is so instructive that we give it entire:

A word in explanation of the fact here shown that the increased load thrown upon the shaft, crank-pin, and cross-head journals does not noticeably increase the friction of engine, will be considered not out of place here. The friction of engine consists of the resistances due to the motion of the various piston, valve and other rods through stuffing boxes and in guides, the friction of the piston rings on the cylinder surface, the friction of eccentrics, and often, other parts which are independent of the magnitude of the load thrown upon the engine by the useful resistance, in addition to the friction of the journals transmitting the effort of the steam to the exterior resisting work, and of the cross-head guides and other parts indirectly affected by its variation. It thus happens that the resistance due to the friction of the latter may be, and often is, but a small proportion of the whole friction of engine. The total friction of engine, as has been seen, in engines of the class here studied, and of the sizes described, amounts to about 10 per cent. of the total power developed when fully loaded; but the coefficient of friction of any one journal, if well lubricated, has been found by the writer, by hundreds of experiments, under such pressures as are usual on the main journals of the steam engine, to fall below 1 per cent., and the absorption of work and energy is thus a still lower proportion of the work of the steam in proportion as the speed of rubbing is less than that of the piston. The loss of power along the line of connection is thus exceedingly small. It should never exceed probably 2 per cent. of the work done, or between 10 and 20 per cent. of the total friction. Again: the coefficient of friction, within the usual range of pressures on these journals and the guides, with good lubrication, increases rapidly as pressures fall, and decreases as greatly when the pressures increase with variation of engine power and load, and this often occurs so rapidly that the total frictional resistance, on these parts, even, varies very slowly with variation of load; while the friction of the other portions of the engine, above mentioned, remains quite constant. The resultant effect is, as shown by the investigation here described, a practically constant friction of engine under all loads, the speed and steam pressure being constant. Whether this is true of condensing engines is doubtful, and it would be an important extension of this research could similar investigations be made of the friction of other forms, and especially the marine steam engine and pumping engines.

In the discussion of this paper Mr. Barrus gave the results of a test of a Westinghouse engine which were, as to friction, very similar to those obtained by Prof. Thurston.

A Corliss engine in France was also shown to have done the same.

Mr. Raynal thought that variable compression and the question of whether the valves were balanced or unbalanced would influence friction.

In the discussion of Mr. West's paper (which appeared last week) Mr. Le Van thought that but little progress had been made in the art of casting. Castings were made 100 years ago as nearly perfect as they are made to-day.

Mr. Walker did not agree with Le Van. He thought that the great complication in castings required at present, and the material of which they were made, showed great progress in the art.

Inquiries were made as to the strength of aluminum bronze, and also as to whether it was subject to blow holes, which Mr. West answered by saying that with one proportion of aluminum the metal would have a tensile strength of about 126,000 lbs., but would be brittle, with no apparent elongation before breaking; other proportions would have less tensile strength, but could be bent readily without injury. A casting which Mr. West had at the meeting, which was in the shape of a hollow cylinder, about two feet in length and 14 inches diameter, with a little more than one inch thickness of metal, answered the question as to the blow holes. It had been turned and bored, and showed absolutely clean. Other specimens showed the elasticity of the metal.

Query 28, of Topical Discussions, was: What is the practical value of the sand-blast process for sharpening files? Mr. Trump said that applied to new files, it increased their usefulness about half, and that after use they could be re-sharpened, still being better than new files not submitted to the process.

Mr. Towne said that the value of the sand-blast process was unquestioned. On new files the edge was turned over, and if used this edge broke off and injured the file in breaking. The sand-blast removed this wire edge.

Mr. Doane wanted to know the power required to operate the sand-blast for the purpose. Responses showed that a commercial 6 horse-power boiler would be sufficient

It was also brought out that the steam pressure should be from 80 to 100 pounds; also one speaker said he used steam of 60 pounds pressure successfully.

"What is the best way to separate grit from grinding rooms and prevent its dissemination in yards?" Mr. Dodge said they placed their fans with a tight room intervening between them and the tumblers. In passing through this room the dust had time to settle.

Mr. Giddings illustrated on the blackboard their plan of a filter and settling the dust by a water jet.

"How may drawings be made and the contraction and expansion of the paper be avoided?" provoked considerable discussion. Mr. Porter thought it was not a matter of much consequence, as all drawings are, or should be marked with dimensions.

Mr. Smith thought it was important, as dimensions could not be conveniently marked in as the draftsman went along, and the next day correct measurements could not be taken.

Mr. Partridge thought if the paper were made fast to the board, the difficulty would be overcome, but other members said that the contraction and expansion of the board would be greater than that of the paper.

Mr. Babcock said that one trouble with paper was it did not contract and expand alike in different directions.

Mr. Emery said they found it possible to secure a quality of paper that did not give serious trouble from contraction and expansion.

"How can intricate patterns be cut from very thin metal?" was answered by the suggestion of covering the surface with wax, drawing the pattern and etching, but it was said that this left a somewhat ragged edge.

Another plan was to place the metal between two thin pieces of wood, mark the pattern on one of the pieces, and saw with a fine jig saw.

In the excursion to Newark the first stop was made at the Statue of Liberty, after which the shops of Hewes & Phillips, the Watts, Campbell Company, and the United States Electric Lighting Company were visited. The fine iron castings for which Newark is noted excited much favorable comment. The Clark's Spool Cotton Company's works were also visited by many of the members, and also Mr. Weston's private electrical laboratory. At all these places the excursionists were made heartily welcome, and many expressions of surprise at the magnitude and excellent character of Newark's industries attested to the fact that some information was imparted.

The Mayor and several Aldermen met the engineers at the Armory, where refreshments were provided, and accompanied them to the places of interest.

New York Railway Club.

On December 7th, 1886, a meeting was held in the rooms of the Master Car Builders' Association. The object of this meeting was the reorganization of the club under the name of "The New York Railway Club," with its headquarters in the city of New York. Mr. R. C. Blackall presided, and Mr. J. B. Brady acted as secretary. It was proposed to secure suitable rooms in a central part of this city, convenient to, or within easy distance of, all prominent hotels and depots. It was also proposed that these rooms should be placed in the charge of a janitor who will be in attendance early and late, caring for baggage, and providing for the comfort of those making the rooms their headquarters; and that meetings should be held from time to time at which live topics can be discussed. Those present at this meeting took a lively interest in the matter, and expressed the opinion that a club composed of railway officials and railway supply men could be successfully organized and maintained, and would be a benefit and advantage to railroad men who make a flying visit to the metropolis for a day and do not register at a hotel.

After discussing the subject fully and freely, a committee was appointed, consisting of Mr. W. R. Corwine, of the *Time-Table and World*; Thomas Aldcom, of the West Shore Railroad; James B. Brady, of the New York Central and Hudson River Railroad; Robert C. Blackall, of the Delaware and Hudson Canal Company; William C. Tyler, of the *Railway Review*; and Thomas Prosser, Jr. The committee will meet at the call of its chairman, Mr. Corwine.

The Master Car Builders' Association has done a great amount of good, and of this there is sufficient evidence; but we believe that a club having a larger scope and work, securing better accommodations in the matter of rooms more centrally located, would be of much service and benefit to railroad officials and others. We sincerely wish it success,

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NEW YORK, DECEMBER 25, 1886.

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The Close of Volume Nine.

The present issue closes Volume IX. of the AMERICAN MACHINIST, and we present as usual an index to the contents of the paper during the past year. It is not our practice to indulge in self-glorification, nor to publish the numerous expressions of commendation and encouragement we are always receiving by mail. But upon the termination of another volume, and the completion of our ninth year of publication, we may properly call attention to some of the good things we have spread before our readers week by week as an example of what they may expect for the year to come. Valuable hints, suggestions, and the records of experience in the machine shop, foundry, engine room, boiler shop, drafting room, pattern shop, and forge shop, can be found by looking over the pages to which the index is a guide, as well as information of general interest to manufacturers and mechanics. Our "Letters from Practical Men" represent a wide variety of information in the mechanical line, drawn from a large number of sources. Our "Questions and Answers" department gives specific answers to a great many queries of a mechanical nature that have been sent us during the year. The index indicates many of the topics that have been brought up. Our department of "Manufactures" has been a weekly record of progress in establishments using machinery—their organization, extension, and success in prosecuting business. Many of our articles have been in serial form, but with a very few exceptions each is complete in itself. One exception is the series of articles now running on "Practical Drawing," by J. G. A. Meyer. These are written from a standpoint of a practical experienced instructor, and are not put forth to ventilate any pet theory or to advertise anybody's productions. Mr. Meyer will continue these articles, also his papers on "Modern Locomotive Construction, which have gained wide attention. Articles on the foundry, pattern shop, and other lines will also appear in the coming volume. The promise of the future is based wholly upon the record of the past. We shall not attempt any startling new departure, for none has been demanded by our readers.

The editorial policy of the AMERICAN MACHINIST will continue to be independent and aggressive. We shall go on freely discussing those matters which are of general interest to the mechanical and manufacturing community, not hesitating to present the facts as we see them in any case.

To our esteemed contemporaries we extend our compliments, and wish one and all of our readers a merry Christmas and a happy New Year.

Notes of the Mechanical Engineers' Meeting.

Prof. Thurston's paper, an abstract of which we give elsewhere, calls attention in a way we do not remember having seen done before, to the reason why the friction of a steam engine does not increase with the load. It is not quite right, however, to assume that all authorities have accepted De Pambour's reasoning in respect to the friction of steam engines. Some fifteen years ago Charles T. Porter wrote: "Experiments with the friction brake have shown no appreciable difference between the losses of power in friction when very small and very heavy loads were being driven by the same engine. There is nothing for confounding superficial reasoning like an experiment."

The discussion of the "labor question," in connection with a paper by Mr. Partridge, which opened the way, cannot be said to have added anything to what has already been said. During the discussion remarks were made reflecting upon the honor of workmen. In conclusion, Vice-President Towne very emphatically took the opposite view. He believed that workingmen, as a rule, were honorable, and disposed to do what they saw to be right.

Professor Reuleaux's paper on "Friction in Toothed Gearing" was strongly criticised but as the criticism was for the most part in the form of quite lengthy written argument, which the time limit prevented giving except in abstract, it is not possible to judge of its merit.

At the excursion to Newark the visitors were shown, at the works of the Watts Campbell Company, the cylinder of the first steam engine erected in this country. It was imported from England by Col. John Schuyler, in 1753, who had a copper mine at Belleville, N. J., and used to pump water from the mine. The success of steam engines for this purpose had become known to Col. Schuyler, which induced him to try it. It was necessary to have an engineer sent over to take charge of the engine. This engine was used at intervals till sometime early in the century.

The boiler is said to have been of copper, upright, eight or ten feet in height and of equal diameter.

The sessions, Thursday, at the Stevens Institute of Technology, were pleasantly preluded and interluded by an inspection of the workshops, laboratories and testing rooms of the Institute. Many new tools and appliances have been added to the workshops, and the other departments named. The advantages offered to students in institutions of this kind become every year more apparent.

Mr. Horatio Allen, in his address Monday evening, referred to the Avery rotary engine as an improvement backwards on Hero's engine, built more than 2,000 years ago. They built three of these engines at the Novelty Works. His argument appeared to be that the arms of the Avery engine offered greater resistance to revolution than the sphere of Hero.

In the discussion on gearing it was stated that in the Morton-Poole grinding machine it was found necessary to substitute involute teeth for cycloidal, to prevent the point of passing of the teeth showing itself on the finished roll. The difficulty of getting sufficiently correct action of teeth of wheels to give steady motion to an elevator was also referred to.

Speaking in a general way of drawing, a member said that the white of an egg, mixed with ammonia, was excellent for holding drawing paper on the board. The paper will be securely held until it is desired to remove it; then by starting up one corner it can be pulled cleanly from the board.

At the Hewes & Phillips Iron Works, and the works of the Watts-Campbell Company, the excellent quality of castings made were the subject of much favorable comment. Those of the visitors who were specially interested in foundry matters spent some time in investigating "how they did it."

The rule of the society restricting the time devoted to any one paper, worked well. Unless this rule had been enforced, the consideration of several papers would have necessarily been postponed.

The centennial anniversary of the promulgation of the Federal Constitution is to be celebrated at Philadelphia in September next. Delegates from all but one of the thirteen original States recently met in that city to make arrangements for the celebration. It was proposed to invite the President and Cabinet, Congress, officials of the Government, foreign representatives, officials of State Governments, civic and other organizations, including the organizations of Labor.

The mere suggestion of inviting Labor organizations raised a sort of tempest in a teapot. Finally by general assent the invitation was worded so as to make no mention of Labor organizations. This in a time of profound peace; but if war should show "his wrinkled front," the members of these Labor organizations would not only be invited but implored to take arms and go to the front, while the individuals who have agreed not to invite them to this celebration would probably be content to drop in at the tail end of the procession—if they concluded to join it at all.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(432) J. R. B., Friendship, N. Y., asks: What is the best way to make dies for screw cutting? *A.*—You will find an illustrated article on this subject in the AMERICAN MACHINIST of Oct. 6, 1883.

(433) A. P., Chicago, Ill., will find description of lacquers for brass in the AMERICAN MACHINIST of February 4, 1882; May 12, 1883, and June 18, 1884.

(434) F. L., Mobile, Ala., asks: How are iron plates covered with zinc? *A.*—They are first thoroughly cleaned, then immersed in a bath of chlorides of zinc and ammonium, and afterwards in a bath of zinc and mercury.

(435) L. A. W. asks: Will you please let me know a good way to temper locomotive engine springs? We temper them in oil, but they do not seem to stand well. *A.*—We do not know of any better way than to temper locomotive engine springs in cotton-seed oil. Of course, to do this successfully requires experience; otherwise results as you mention will naturally follow.

(436) J. E U., Lynn, Mass., asks: What is your opinion of carrying the feed water for an upright boiler three or four times around inside of bonnet before it enters the boiler? Water is already heated to temperature of exhaust steam; what would be the gain in temperature, if any, and what would be the objections? *A.*—There are no objections if the piping is well done. What the increase of temperature would be would depend upon the temperature of the escaping gases and the amount of pipe. You may possibly increase the temperature to nearly that of the water in the boiler.

(437) J. H. C., Roseland, Ill., writes that the hole to steam gauge was formerly 9-64 inch, but is clogged to 1-32 inch, and asks if this would make any difference in the pressure as indicated by the gauge? *A.*—So long as the hole remains sufficiently open to let pressure to the spring, its exact size makes no difference. For instance, the pressure would be the same with a one-inch opening that it would be with a ⅛-inch. But it would be wise to remove the scale, otherwise the hole may become entirely closed.

(438) J. G., Boston, Mass., asks: What is the extreme limit of safe pressure on a 48-inch boiler of ¼-inch iron, in constant use for twelve years; also for a similar boiler of 5-16 iron? *A.*—Without knowing anything of the quality of iron, if if looked well, we should make a thorough inspection, and if no signs of weakness were found, after a hydrostatic test 50 per cent. greater, should allow pressures of 50 and 60 lbs. respectively if the longitudinal seams were double riveted, and 10 lbs. less if single riveted.

(439) L. C. B., Hornellsville, N. Y., asks: Can I heat a room quicker by opening the drip pipe wide, leaving no pressure on the heater, than by leaving it open just enough to let off the water of condensation? *A.*—By just keeping the water out of the heater, you will get a little advantage from the increased heat due to the higher pressure, and should heat the room a little quicker. It is not, however, so much a question of heating quickly as economically. A drip kept wide open will waste a good deal of steam after the heater gets hot.

(440) J. M. W., Bay City, Mich., writes: In four boilers there has been a mistake in laying out the holes in the straight seams, and two rows of holes have been cut out, and the plates butted together with a covering plate on the outside, with four rows of rivets. These riveted seams will be in the fire. Do you think this construction safe? *A.*—We should object to putting these covering plates and rivets in the fire. We think they will be very likely to burn out. Otherwise they can be made strong enough.

(441) A. F., Mt. Olive, Ill., asks: 1. Give me a rule by which I can find the saving by putting feed water in the boiler at 200° instead of at 40°? *A.*—You do not state what the steam pressure is. From a book on steam engineering, you can find the heat units of steam and water, and from this what the per cent. of saving will be by imparting a portion of this heat. For practical purposes, it will be safe to calculate that for every 11 degrees of heat gained in the heater there will be a saving of one per cent. in fuel. In your case you gain 200—40=160° in the heater, or a saving of 160÷11=14 6-11; say, 14½ per cent. of fuel. 2. About how many cubic feet of air must pass through the grate to burn one pound of soft coal? *A.*—About 260. 3. How many pounds of dry ashes will there be after burning one ton of good soft coal? *A.*—The incombustible matter may be about 8 per cent. of the total weight. It may vary anywhere from 5 to 25 per cent., according to quality of coal.

(442) G. E. G. asks: 1. In four and five step cone pulleys for lathes, do the cones vary regularly, as 5, 7, 9, 11 inches, etc.? *A.*—No; not necessarily nor generally. The variation in sizes must be such as to preserve the proper speed, and also such that the belt will be the right length when shifted. 2. Will old lead pipe and antimony make good lining for boxes for shafting? *A.*—Not so good as lining metal you can buy.

(443) L. A. W. asks: Will you please let me know the price of a set of draftsman's tools suitable for a beginner? *A.*—Different grades of drawing instruments can be obtained, and consequently the prices will also vary. Our advice is to buy the best; the prices of these will be about as the following:

A five-inch drawing pen, $1,10.
4½-inch plain dividers, $1.50.
4½-inch compasses, with all attachments, as illustrated in the drawing articles, $8.
T square, $1.
Set square, 25 to 40 cents each.
Drawing board, $2.

You can buy tools somewhat inferior to the above for 25 per cent. less.

(444) E. H. C., Warrensburg, Mo., asks.: 1. With the same length of barrel, same bore and charge, will not a cast-iron barrel give the same penetration of shot as a fine twist barrel? *A.*—Conditions being the same as to smoothness of bore, we do not think there will be any difference. 2. Does not choke-boring lessen the penetration? *A.*—We do not think so, to any noticeable extent. Theoretically, it might be said that a little energy would be expended in huddling the shot, but we think it would be so slight as not to be noticeable.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Mechanical and Patent Office Drawings executed at reasonable rates, by A Mugford, Hartford, Ct.

20", 25," 28" B G. and S. F upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 120 built, and all successful, by David Boyle, 521 Monroe, Chicago, Ill.

N. B. Non-breakable Drills and Taps. A. P. Brown, 108 Liberty st., N. Y.

The best wire nail and tack and nail machinery. Wm. A. Sweetser, Brockton, Mass.

20,000 addresses of steam users and users of mach. in 10 States, $10. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 93 John st., N. Y.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Rubber Belting, all sizes, 77½ per cent. regular list. All kinds of Rubber Goods at low prices. Jno. W. Buckly, 156 South street, New York.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See Dec. 11, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Machinists' supplies, brass goods m'f'rs supplies, polishing materials, all kinds wire, metals, etc; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co. 111 Liberty st., N. Y.

Handbook on the Care of Boilers. 50c. Descriptive Circular and Catalogue of Books for Mechanical Engineers free on application; special terms to Mechanics' Libraries. E. & F. N. Spon, Publishers, 35 Murray st., New York.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price, $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

MANUFACTURES

Kane & Co., Johnstown, N. Y., will build boiler-shops.

Edward Spelman, Peoria, Ill., will rebuild his large distillery.

The iron works of J. D. Hazlet, at Meadville, Pa., are being enlarged.

The Duluth Stove Works, Duluth, Minn., will build a new factory.

The Globe Iron Works, of Cleveland, O., will remove to Loraine.

J. Forbing & Sons, Kenton, Ky., will erect a large chair factory at Lexington.

The Nanantum Worsted Company, Nanantum, Mass., will build a machine shop.

M. Williams, Chicago, Ill., will build a factory at 234 Newberry avenue, 109x139 feet.

Sharp & Ketchum, Monticello, Me., are erecting a saw mill. This is a lively firm.

The Forest City Furniture Company, Rockford, Ill., will build a large addition next spring.

J. A. Long & W. B. Raymond, Akron, O., will build a factory for making locomotive headlights.

The Victor Mowing Machine Company, at Niverville, N. Y., is about to add a foundry to the works.

Louis Fleischmann will erect a $62,000 yeast factory at Avenue B and Eighty-first street, New York.

J. H. Simonton & Co., Rockland, Me., employ nearly 1,000 women in the manufacture of flannel shirts.

George Heyman, 179 Canal street, New York, will erect an $18,000 factory at 108 West Eighteenth street.

The New York Central Sleeping Car Company Buffalo, N. Y., will erect several new worksnops; cost, $75,000.

The Ansonia Brass and Copper Company, Ansonia, Conn., is building a brick shop, 80x200, for rolling copper.

P. C. Holmes & Co., Gardiner, Me., have just issued the seventh and eighth supplements to their catalogue of bevel gears.

Farmington, N. H., votes to exempt from taxation for ten years the stock-in-trade of any shoe manufacturer locating there.

James Planter, 104 South Elliott place, Brooklyn, N. Y., will erect a six-story factory at 259 William street, New York, to cost $19,000.

L. J. Russell, of Milldale, Conn., is going to build a shop at Hillsboro Bridge, N. H., for the manufacture of pumps and steam engines.

The Toledo, Ann Arbor and North Michigan Railroad Company will commence the erection of a new round-house in Owosso, Mich.

The Union Pacific Railroad Company are working on the foundation of several large buildings at Council Bluffs, Iowa. They will be used for machine shops and freight.

Greenfield, N. H., has voted to exempt the soapstone industry of Williams & Co. from taxation, and, should it locate there, to give a piece of land for building purposes.

The number of manufacturing industries in Atlanta has increased from 196, in 1880, to 303, in 1886. The capital has increased from $2,438,456 to $6,560,000, and the number of employes from 3,665 to 6,674.

Westinghouse, Church, Kerr & Co. are erecting for the Torrington Electric Light Company an incandescent plant of 500 lights capacity. Water power will be used, and the streets will be lighted by the same system.

The Maine Central Railroad Company shops, now building at Waterville, Me., will cover eight acres of land, and are to be completed next spring. The company has secured 25 to 30 acres of land for shop purposes.

The Beaumont Iron Works Company, Beaumont, Tex., write us: "Business in this part of Texas is good, lumber interest moving up in prices, and orders in machinery increasing. We have contracts ahead for ice machinery for coming year."

A North Adams (Mass.) manufacturer says that weekly payments make a decided increase of drunkenness in his mill, and especially of late, when he has had to discharge some of his help for their weekly debauches who were quite temperate before the new plan began.

The Philadelphia *Public Ledger* is replacing its present motive power with a series of independent engines. The Westinghouse engine has been selected, three of which will be coupled direct to the presses. Another will drive the electric light plant, and one the ventilating fans.

The buildings to be erected for the Boynton Furnace Works on Pacific avenue, Jersey City, N. J., consist of one brick factory, 50x125 feet and four stories high; a foundry, 95x115 feet; and a boiler and engine room. The buildings will cost $20,000, and contracts for their erection have been let.

The Chicago, Burlington and Northern Railroad Company have taken out permits for and will build on their grounds on Mississippi street, near York street, St. Paul, Minn., an engine, oil and coal house. This is near the extensive improvements being made by the St. Paul and Northern Pacific.

Warwick, Mass., is making a bid for new business enterprises. At a recent meeting of the townspeople, five men offered to subscribe $100 each for any concern who will start a business in town for five years. W. D. Jaynes, F. P. Stockwell, W. H Bass and A. Gale are the committee to extend the offer.

Two hundred and fifty Spencer magazine "riot" guns, which are made at Windsor, Conn., are to be distributed among the Ohio militia regiments for use in the event of riots. Something must be terribly wrong in this free and enlightened country when necessity arises for arming militia with special "riot" guns.

The Kansas City Car Wheel Company, of Kansas City, Mo., has recently been formed, with $100,000 capital. They will build a factory in a suburb called Rosedale. The parties interested are St. Louis men, as follows: Wm. McMillan, W. H. Gardner, A. T. Buchanan, R. B. Doyle, James Connelly, M. Sawyer and O. L. Brigham.

The Troy (N. Y.) Mowing Machine Company have issued a circular letter, to the effect that they are in possession of the extensive line of patterns formerly in use by Starbuck Brothers, of that city, consisting of patterns for dredging machinery, steam engines of all kinds, gear and pulley patterns, and patterns for mill work generally, from which they will furnish castings either finished or rough.

The foundry of the Westinghouse Machine Company at Pittsburgh, and the Malleable Iron Works of McConway, Torley & Co., were destroyed by fire on the 14th of November. The latter firm will rebuild in another location, and the Westinghouse Machine Company have secured the entire block, on which they will erect a new foundry and other buildings. The works of this company now cover nearly three blocks of ground.

Restrie, Campbell & Co., Chattanooga, Ga., will make an extensive addition to their furniture factory. The grounds for the several new buildings to be erected have been cleared off, and the buildings will be in course of construction within ten days. The new machinery has been ordered for the factory. The firm proposes to expend $10,000 to $15,000 in improvements, which, when completed, will give them one of the most extensive factories in the South.

Arrangements have been made for the sale of the Sloss Furnace Company's property at Birmingham, Ala., to a syndicate of buyers from Richmond, Va., New York city and Alabama. The price to be paid is $2,000,000—more than half of it in cash. The new company will be known as the "Sloss Steel and Iron Company." The property comprises some of the most valuable coal and iron lands in the South, besides two furnaces in successful operation. Two more furnaces will be erected at once.

The Pulsometer Steam Pump Company have just received an order from the Japanese Government for pulsometer pumps to the amount of $5,700. This order was the result of the working of two previously shipped. They have just filled an order for two large pumps from the A. T. & S. F. Railroad, being the fourth order received from them. Have also shipped the National Soldiers' Home, Hampton, Va., a plant for pumping sewage, the result of having used one pulsometer for the past year. They have just furnished pumps to Kingsessing & Tinicum Meadow Co., of Philadelphia, capable of handling 2,500,000 gallons in twenty-four hours; also a number to the Red Star Line, and several for irrigating purposes in Southern California.

The proposed incorporation of the Howe Scale Company is to provide for a reorganization of the concern under the foreclosure obtained by the National Bank of Rutland. Should those interested in the bank be unable to bring about a reorganization giving them an interest in the management, a new company is likely to take hold of the matter. Business at the scale works is reported to be excellent just now, and the force is the largest employed there for years. Besides the foreclosure, which involves claims amounting to about $100,000, the company has $150,000 in bonds, while the savings bank holds a first mortgage of $20,000. It is believed that the works can be readily made to pay a profit of $50,000 a year, which would more than pay the interest on the debt.—*Boston Commercial Bulletin.*

The new yarn mill now building for the Amoskeag Corporation at Manchester will be about the same size as the Amory mill, the largest in the State. It is of brick, and the main portion is 500x100 feet, four stories. Connected is a picker building, 150x120 feet, three stories. The machinery will be mostly new, the cards coming from the shops of Platt Bros., England. The product will be about 100,000 pounds of yarn per week. Three pairs of Ridson turbine wheels will furnish motive power of a capacity of 2,000 horse-power. It is expected that the machinery will start by February 1st. Employment for 400 hands will be given, thus increasing the Amoskeag working force to 5,600. The cost of the new mill will be $750,000.—*Boston Commercial Bulletin.*

The *National Labor Tribune*, of Pittsburgh, says, in its issue of December 4th: "There is no change to note in Pittsburgh's iron and steel business. The demand is still increasing, and the outlook for five more months could not be any better. Six months ago we stated that the outlook was good for a year, and from the appearance now it would seem as though a constant run is certain for a number of years. Great improvements are being made everywhere. It is only a short time since the work of putting up new puddling furnaces was begun, and now the work of enlarging the pipe works has been started. As a general thing, at this time of the year there is a drop in the business. Two years ago the volume in iron alone was over 500 tons a day less than now. Some firms were soliciting orders then that are now refusing contracts. We have about four firms that are certain of plenty of work for nearly two years; one especially has enough booked to keep running on double turn for fully eighteen months."

George Westinghouse has just purchased a piece of ground at the corner of Penn avenue and Ninth street, Pittsburgh, on which to erect an imposing office building. The property has a frontage of 80 feet on Penn avenue, and extends back along Ninth street 110 feet to Exchange alley. The price paid was $78,000, being almost $1,000 a foot. The new building will cost at least $200,000. It will be a magnificent structure eight stories in height. Pressed brick, with terra-cotta finish, is the material to be used. The building will contain all the offices of the Philadelphia Gas Company and all Mr. Westinghouse's other offices, including the Westinghouse Air Brake Company, the Union Switch and Signal Company, the Westinghouse Machine Company, the Westinghouse Electric Light Company offices, Westinghouse, Church, Kerr & Co., and the Safety Appliance Company. The edifice will be known as the "Westinghouse Building," and it is expected to be ready for occupation next July.

Since October 1st Beaudry & Cunningham, of Boston, Mass., have booked orders for the following sizes of their upright cushioned hammers, viz.: Munson Bros., Utica, N. Y., 100 lbs.; S. H. Brown, E. Boston, Mass., 250 lbs.; Collins & Clark, Oak Center, Wis., 25 lbs.; Michigan Buggy Co., Kalamazoo, Mich., 50 lbs.; Klein Bros., Hoboken, N. J., 75 lbs.; Iron City Tool Works, Pittsburgh, Pa., 250 lbs.; Industrial Iron Works, Kansas City, Mo., 250 lbs.; City Carriage Works, Fort Wayne, Ind., 50 lbs.; Goodell Cutlery Co., Antrim, N. H., 50 lbs.; Fontaine Crossing and Signal Co., Toledo, O., 300 lbs.; the Brown Cotton Gin Co., New London, Conn., 200 lbs.; McMyler Manufacturing Co., Cleveland, O., 125 lbs.; Milburn Wagon Co., Toledo, O., 50 lbs.; F. W. Wurster, Brooklyn, N. Y., 500 lbs.; McConway & Torley, Pittsburgh, Pa., 50 lbs.; Hayes File Co., Detroit, Mich., 25 lbs.; Diamond Iron Works, New York, N. Y., 125 lbs. Some of these are repeated orders, like that of the Goodell Company, which is the fourth order received from that company within eighteen months.

The M. C. Bullock Manufacturing Company, of 156 and 158 Lake street, Chicago, report the following important shipments of machinery: To the Union Steel Company, of Chicago, three special No 15 portable "band friction" hoisting machines; to the Troy Edison Electric Light Co., one 13x18 (100 horse-power) straight-line engine; to the Harmouth Gold Mining Co., Tucson, Arizona, one No. 13 special portable "band friction" hoisting machine, with wire rope, sheaves, etc.; to Capt. John Perkins, Horray, Mich., one double No. 13 portable "band friction" hoisting machine; to the Hugump Mining Co. (silver), Rapid City, Dak., one No. 9 portable "band friction" hoisting machine, including boiler, sheaves, etc.; to the Eureka Mining Co. (silver), Rapid City, Dak., one No. 9 portable "band friction" hoisting plant, boiler, sheaves, etc; to the Hononth Mining Co., for their famous Chapin Mine at Iron Mountain, Mich., two plants of direct hoisting machinery; one plant, consisting of a pair of 30x60 (500 horse-power) Corliss engines, connected at right angles to the drum shaft mounted on this shaft are a pair of cone-shaped, wrought-iron drums, 14½ feet diameter at the large end by 10 feet diameter at the small end. The drums are driven by a Lane patent "band friction" driving band, arranged to run in balance, one turn unwinding and lowering the empty cage, while the other drum winds up, hoisting a load of six tons of ore (besides the weight of cage and rope) at a speed of 1,200 feet per minute.

Frank Hill writes us from Dallas, Tex.: "A short time ago the Case Manufacturing Company got a contract to build a mill at Coleman, and rolling mills are getting quite common throughout the State. Pilot Point is getting up a stock company to build a 75-barrel mill, and one man there is talking of building a roller corn meal mill; he was here to see me last week about a boiler. The castor oil mill at Weatherford started last week, and several towns are advertising for bids for water-works, and some have water-works. Sherman is getting a gin ready for next year with 100 bales capacity—the largest gin in the State. Munyer, a Dallas manufacturer, is putting in his pneumatic system to handle the cotton to and from the gins. This system does not allow the cotton to pass through the fan. The Todd mills have put in two new boilers, and are running while setting the third. The new corn meal roller mill has been running about a month, and the electric light plant is being enlarged all the time. One of the steam brick yards will double its capacity in the spring, and is now looking at the different engines for sale. Several railroads have been chartered lately, and 1887 bids fair for a boom in this direction. The Dallas Fair and Exposition are enlarging, and next year you can look for a rouser. We will soon have railroad competition on coal rates, and then Dallas is the field for Eastern capital to seek for manufacturing. Good, substantial brick and iron buildings are going up all over the city, and the city is steadily spreading out. The sixth railroad is nearly here, and they are starting the seventh."

Machinists' Supplies and Iron.

NEW YORK, Dec. 8, 1886.

In the condition of the pig iron market new features have not been developed since the close of last week, and official announcement has not yet been made respecting the basis for next year's contract. However, the tone of the market is firm, and very little first-class Foundry is offering below $19.50 to $20.

We quote: For American brands, No. 1 X Foundry, $19.50 to $20, and for special brands still higher prices are named; No. 2 Foundry, $18; and Grey Forge, $16.50 to $17.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Situation wanted by mech. draftsman in a Western city. Address Western, AM. MACHINIST.

First-class machinist desires situation as foreman in manufacturing concern or small machine shop; good reference; village preferred. G., AM. MACH.

Mech. engineer and draftsman, experienced in designing special machinery, wants situation. Address Box 9, AM. MACHINIST.

Position as superintendent or draftsman in shops doing engine and machinery building; West preferred. A. S. M. E., care AM. MACHINIST.

Wanted—Situation as foreman patternmaker; 20 years' experience; also a draftsman; good references. Address K. K., AM. MACHINIST.

An experienced patternmaker and draftsman, with some capital, wishes to change his situation. Wm. H. Billing, 606 Cherry st., East Saginaw, Mich.

Wanted—Situation by practical engineer; adjusts and repairs modern automatic engines; use indicator. Address D. G. J., care AM. MACHINIST.

Mech'l draftsman—12 years' experience on steam engines and special mach'y—wants situation in N.Y. or vicinity. Address "Skill," AM. MACHINIST.

Wanted—Position as general foreman of large machine shop; have been 12 years foreman. Address Box 10, AM. MACHINIST.

Mech'l engineer—best of references, past experience railroad and marine engine work—wants situation as master mechanic. Address E. B., AM. MACHINIST.

Wanted—Good diemaker, thoroughly acquainted with combination and cutting dies; to right man constant employment and good wages. Address W. H. Banfield, 78 Wellington st., West, Toronto, Canada

Wanted—Correspondence with a competent man, with a view to build and superintend a modern iron pipe mill. Address Mill, office AM. MACHINIST, 96 Fulton st., New York.

Wanted—Situation by a practical machinist accustomed to marine and stationary engine work, toolmaking and general jobbing Address "Marine," AM. MACHINIST.

Wanted—A foreman for machine shop; one who thoroughly understands the working of stationary and portable engines; give past experience, with references, and state salary expected. Address Foreman, Box 11, AM. MACHINIST office, 96 Fulton street, New York.

Wanted—Position as designer and draftsman or superintendent by an extensively-experienced designer, delineator and constructor of all classes of general and modern machinery; references; salary low. Address D., No. 44 E. 6th st., Oswego, N.Y.

Wanted—Superintending engineer for a large works engaged in manufacture of general machinery in an Eastern city; must be experienced and energetic. Address confidentially, with full information, A. A. B., AM. MACHINIST, N. Y. city.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent solid lubricant, clean, durable, cheap; prevents hot boxes. Crescent Mfg. Co., Cleveland.

The Crescent automatic grease cup is adapted to every service. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

John Lamberty, mfr. telegraph and electrical instruments, experimental machs, models; fine gear cutting a specialty. 35 S. 5th st., Br'kl'n, E.D., N.Y.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

Experimental and new machinery for special purposes built by contract from specifications and inventors' designs; ample facilities. Cohoes Iron Foundry and Machine Co., Cohoes, N. Y.

For Sale—One complete set of Pulley Patterns also Patterns for Slide Valve Engines, with adjustable cut-off and without cut-off, for sale cheap Address North Star Iron Works Co., Minneapolis, Minn.

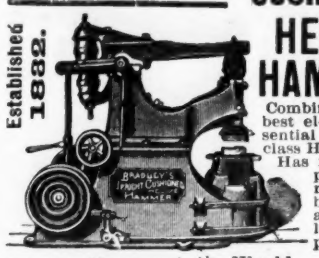
Wanted to communicate with reputable and responsible parties in or near commercial centers, who would build a first-class water-tube boiler on royalty basis. Address L. J. G., AM. MACHINIST.

Correspondence solicited for the manufacture of a staple article for local supply (viz., New York or other States, as preferred), weighing from one to three pounds; fully covered by U. S. and foreign patents. All requisite machinery and tools (mfg. by Pratt & Whitney) on hand ready for use. The demand almost unlimited and "margin" ample, as can be readily shown. Address J. H. Jenkins, care AM. MACHINIST.

Wanted—Partner with capital to manufacture small automatic engines; have patterns and tools for manufacturing three and ten horse-power now, and several engines in operation; parties desiring investment and meaning business please investigate. Address S. A. J., AM. MACHINIST.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.



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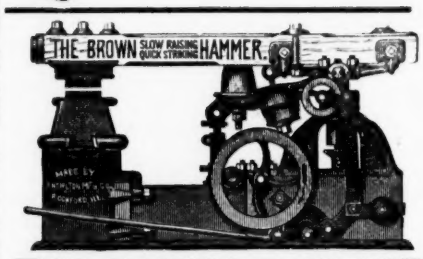

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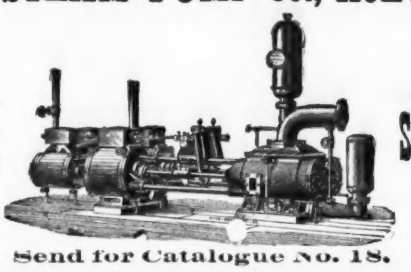

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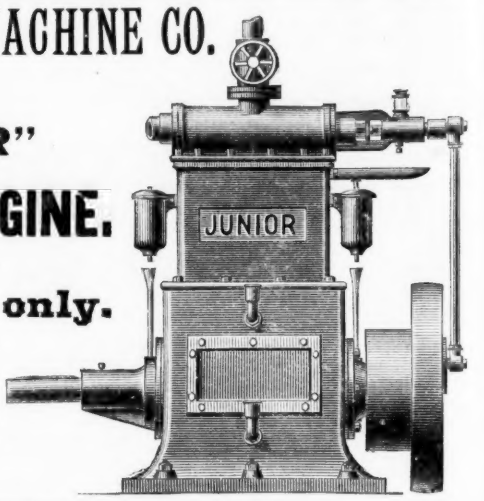

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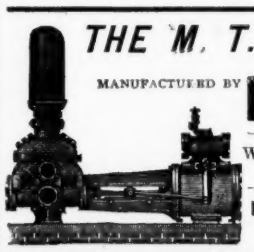

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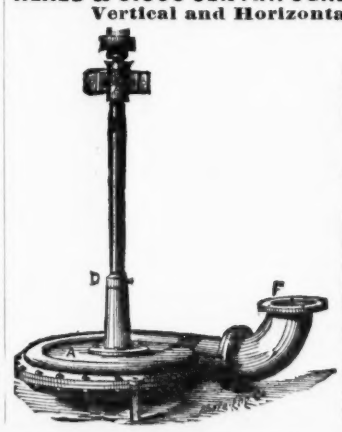

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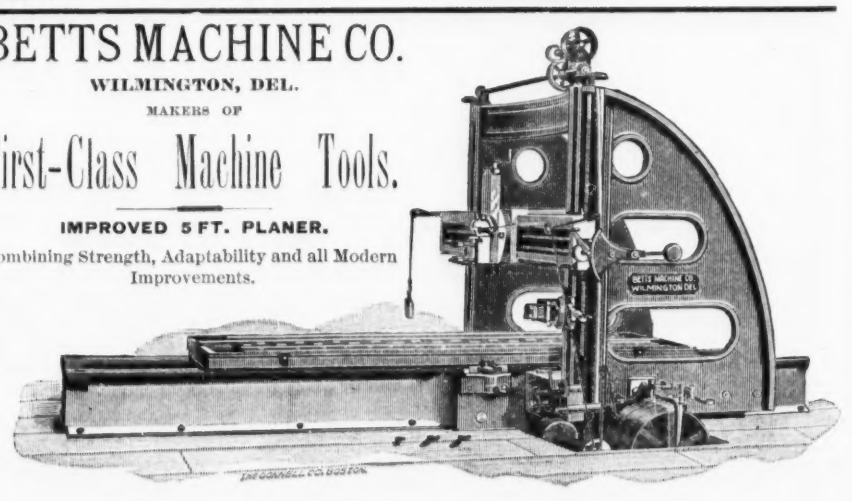

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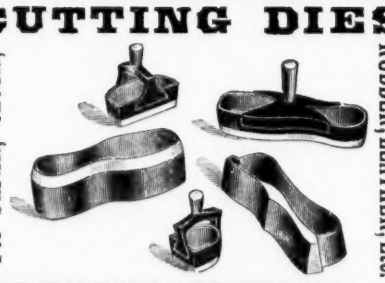

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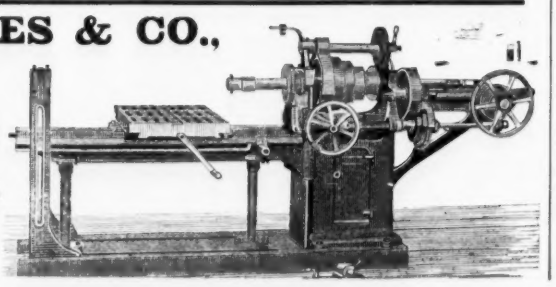

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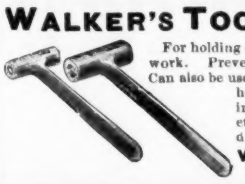

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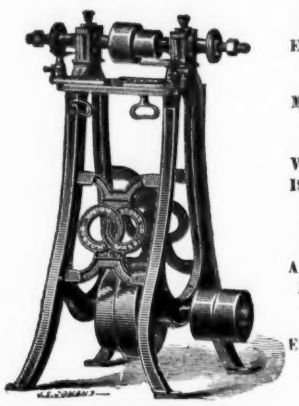

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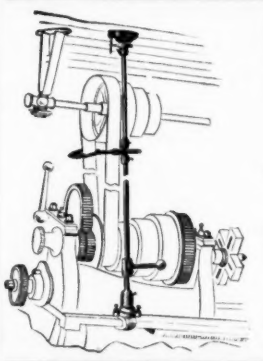

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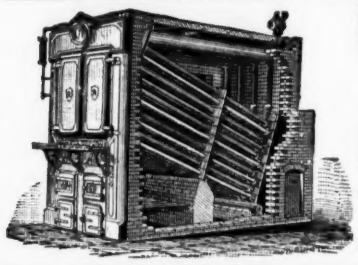

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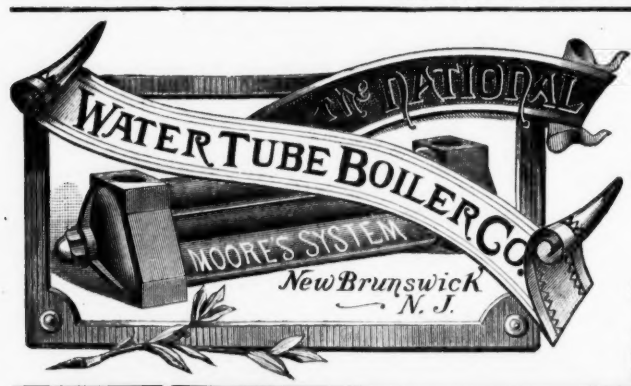

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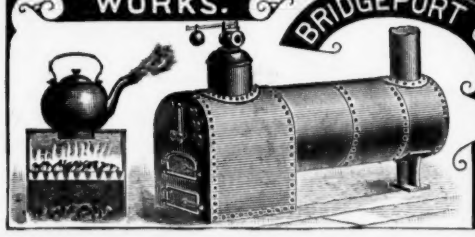

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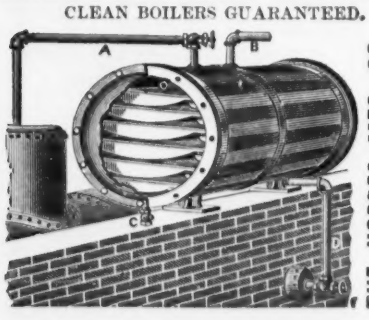

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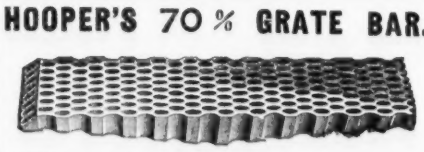
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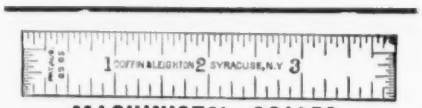

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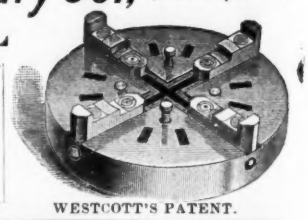
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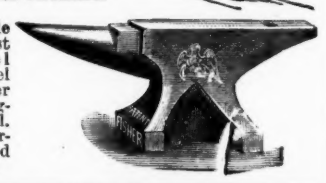
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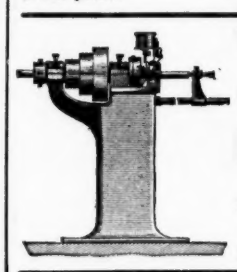
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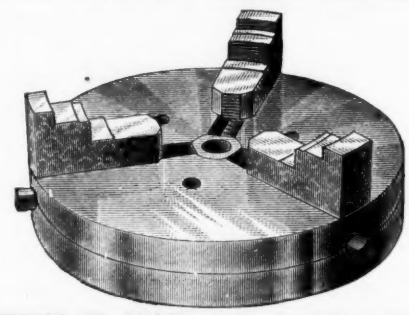
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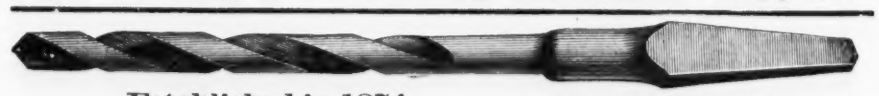
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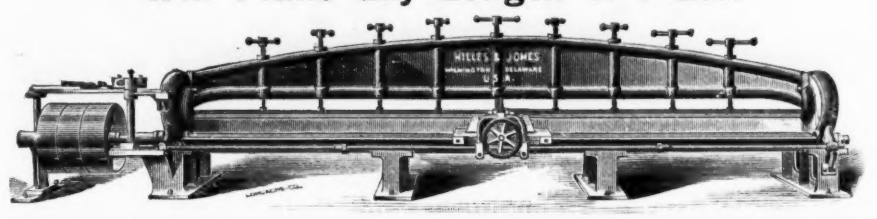

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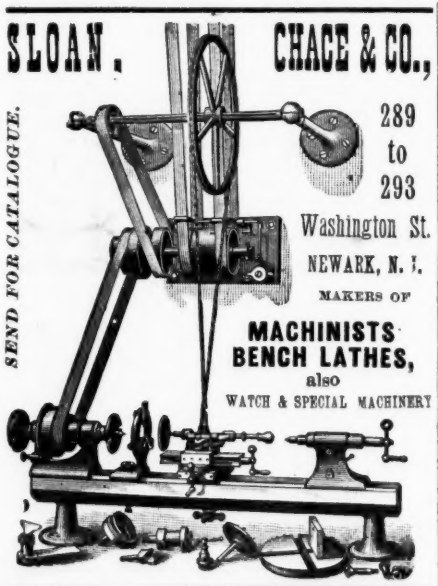

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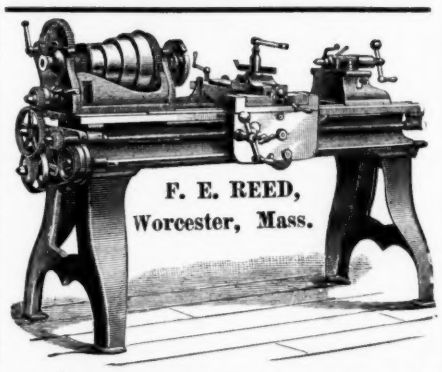

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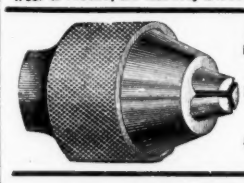

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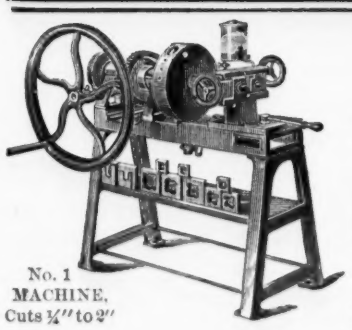

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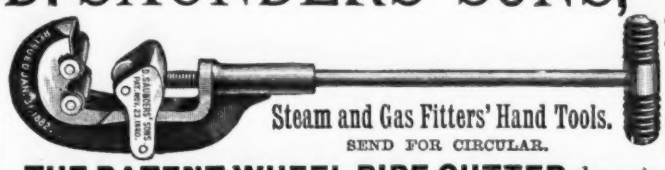

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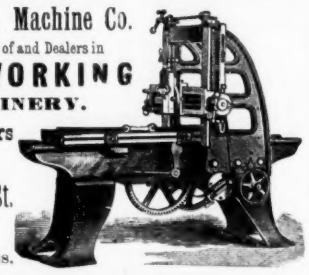

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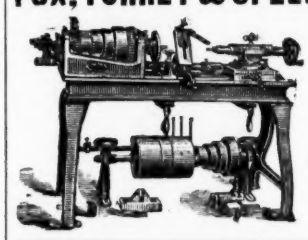

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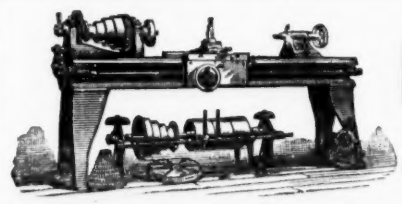

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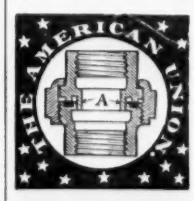

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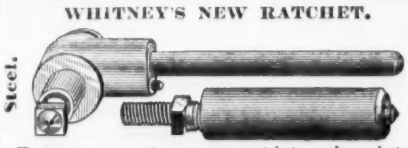

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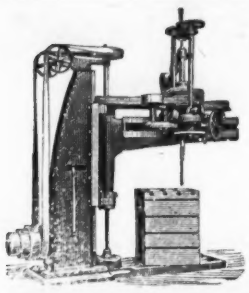

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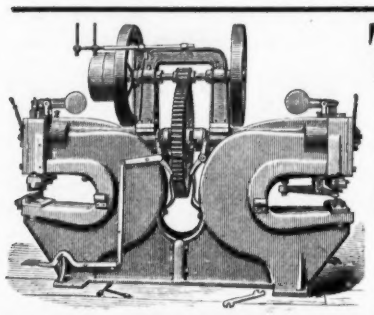

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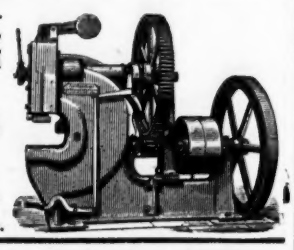

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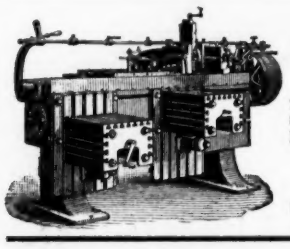

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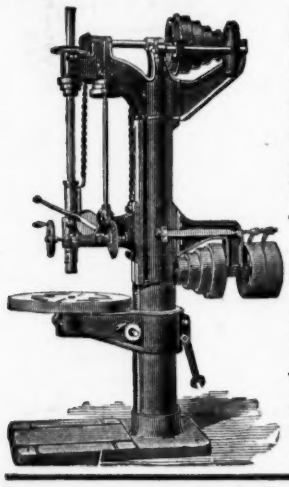

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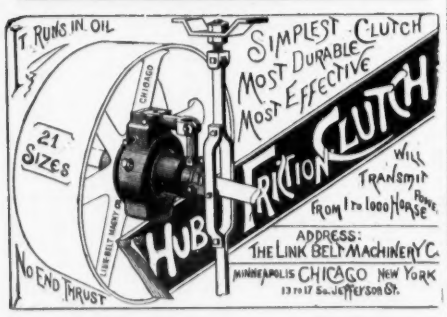

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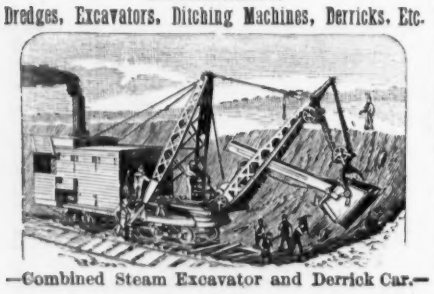

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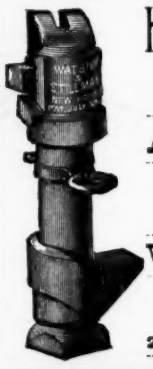

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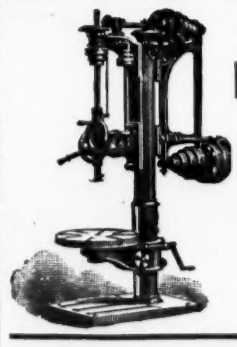

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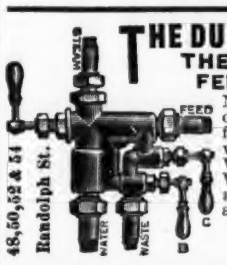

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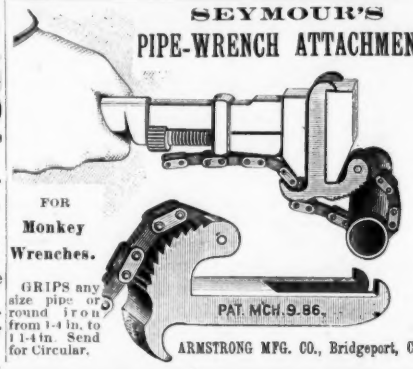

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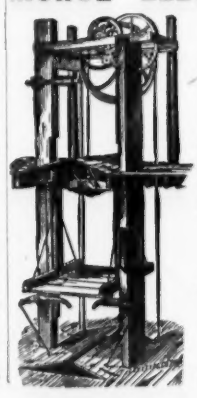

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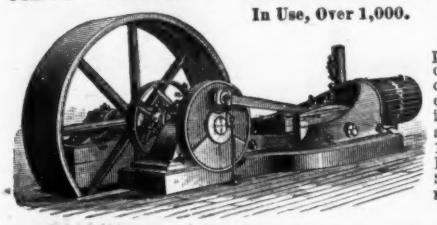

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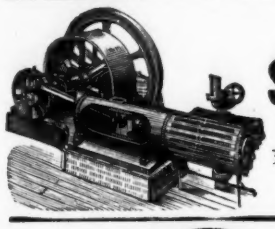

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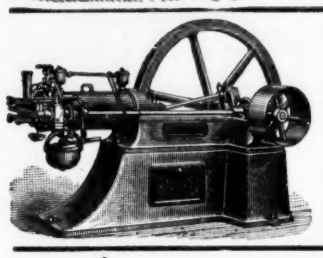

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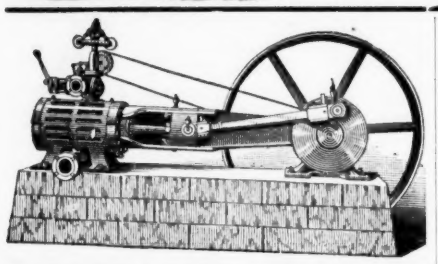

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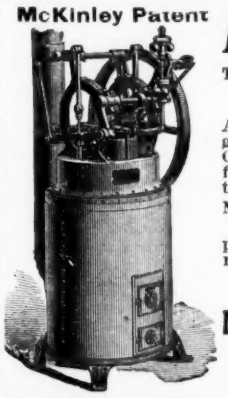

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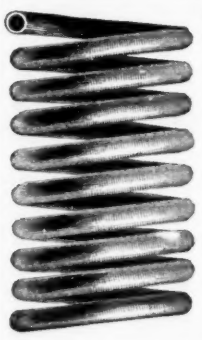

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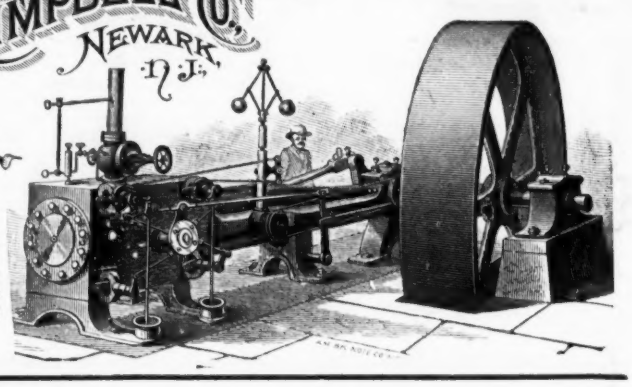

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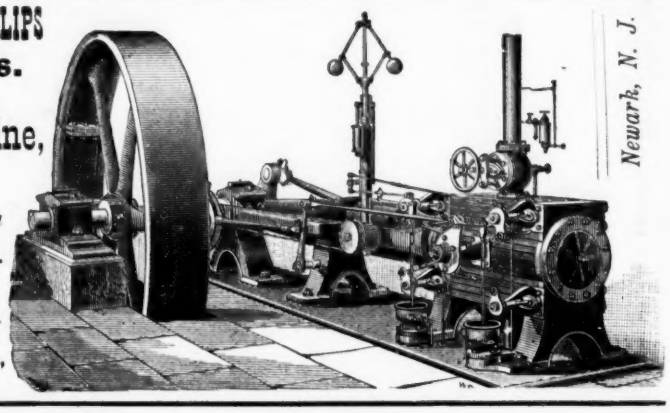

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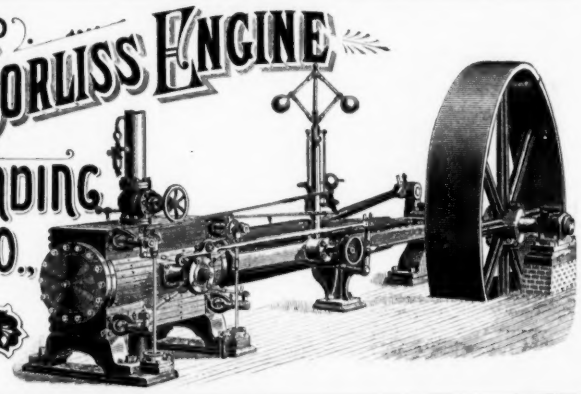

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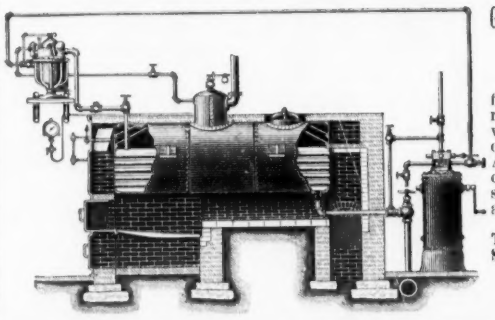

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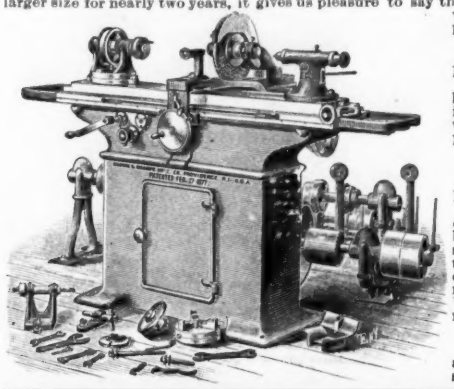

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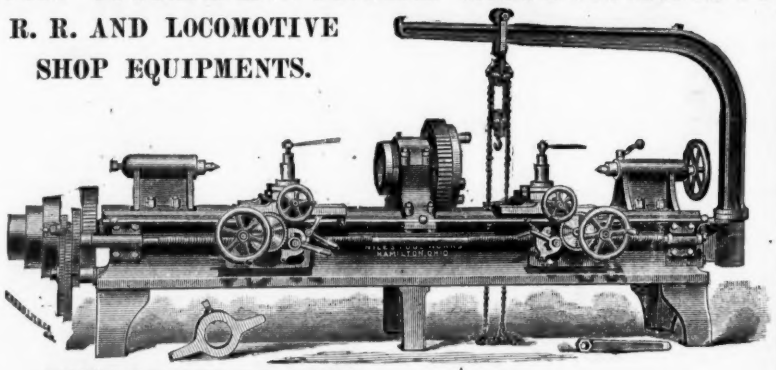

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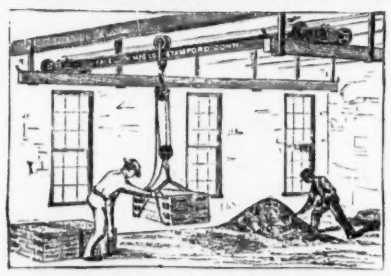

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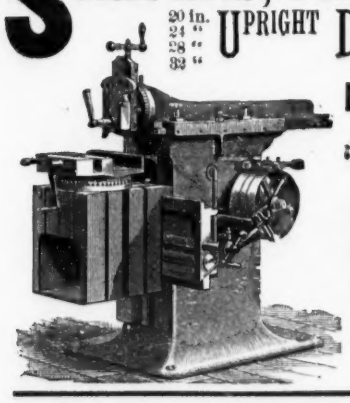

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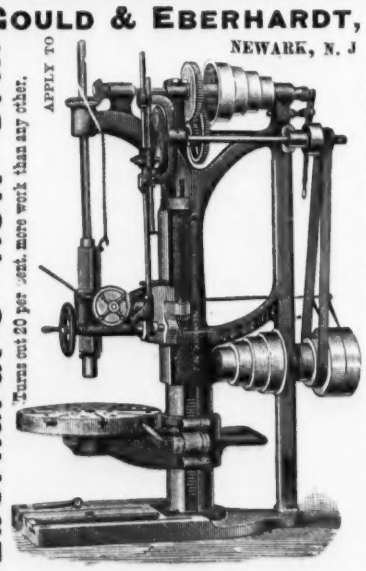

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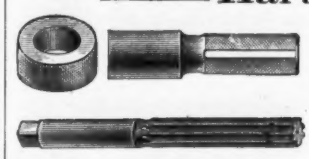

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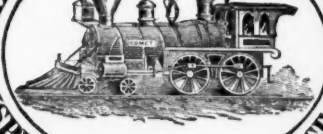

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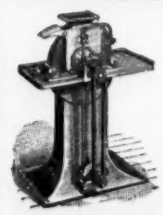

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